IBM Parallel Environment for AIX 5L

Operation and Use, Volume 2
Using the Parallel Operating Environment

Version 4 Release 2

SA22-7949-02

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Note

Before using this information and the product it supports, read the information in “Notices” on page 163.

Third Edition (April 2005)

This edition applies to version 4, release 2 of IBM Parallel Environment for AIX 5L (product number 5765-F83) and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces SA22-7949-01. Significant changes or additions to the text and illustrations are indicated by a vertical line (|) to the left of the change.

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Contents

About this book

This book describes the facilities and tools for the IBM® Parallel Environment (PE) for AIX® program product and how to use them to debug and analyze parallel programs. Specifically, it contains information on PE's debuggers and profiling tools.

This book concentrates on the actual commands, graphical user interfaces, and use of these tools as opposed to the writing of parallel programs. For this reason, you should use this book in conjunction with *IBM Parallel Environment for AIX: MPI Programming Guide*, (GC23-3894) and *IBM Parallel Environment for AIX: MPL Programming and Subroutine Reference* (GC23-3893).

This book assumes that AIX 5L™ Version 5.1 (AIX 5L 5.1) or later, X-Windows, and the PE software are already installed. It also assumes that you have been authorized to run the Parallel Operating Environment (POE). The PE software is designed to run on an IBM RS/6000 SP, an @server pSeries® or RS/6000® network cluster, or on a mixed system where additional pSeries or RS/6000 processors supplement an SP™ system. References to RS/6000 SP or SP include currently supported IBM @server Cluster 1600 hardware. For complete information on installing the PE software and setting up users, see *IBM Parallel Environment for AIX: Installation*, (GC23-3892). For information on POE and executing parallel programs, see *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment* and *IBM Parallel Environment for AIX: Hitchhiker's Guide*.

Who should read this book

This book is designed primarily for end users and application developers. It is also intended for those who run parallel programs, and some of the information and tools covered should interest system administrators. Readers should have some experience with graphical user interface concepts such as windows, pull-down menus, and menu bars. They should also have knowledge of the AIX operating system and the X-Window system. Where necessary, this book provides some background information relating to these areas. More commonly, this book refers you to the appropriate documentation.

How this book is organized

This book contains the following information:

- Chapter 1, "Using the pdbx debugger," on page 1 describes the Parallel Environment's command line debugger – **pdbx**. This tool uses a line-oriented interface, allowing you to invoke a parallel program from an ASCII terminal.
- Chapter 2, "Analyzing program performance using the PE Benchmarker toolset," on page 33 describes the various tools in the PE Benchmarker toolset. You can use these tools for collecting and analyzing program event trace or hardware performance data.
- Appendix A, "Parallel environment tools commands," on page 73 contains the manual pages for the PE commands discussed throughout this book.
- Appendix B, "Command line flags for normal or attach mode," on page 147 shows the command line flags for **pdbx** debugging in normal or attach mode.

- Appendix C, "Profiling programs with the AIX prof and gprof commands," on page 149 describes how to use the AIX profilers **prof** and **gprof** to profile parallel programs.
- Appendix D, "Supported Power5 PMAPI hardware counter groupings," on page 153.

Conventions and terminology used in this book

This book uses the following typographic conventions:

Table 1. Conventions and terminology used in this book

Convention	Usage
bold	**Bold** words or characters represent system elements that you must use literally, such as: command names, file names, flag names, path names, PE component names (**pedb**, for example), and subroutines.
`constant width`	Examples and information that the system displays appear in `constant-width` typeface.
italic	*Italicized* words or characters represent variable values that you must supply. *Italics* are also used for book titles, for the first use of a glossary term, and for general emphasis in text.
[item]	Used to indicate optional items.
<Key>	Used to indicate keys you press.

In addition to the highlighting conventions, this manual uses the following conventions when describing how to perform tasks.

User actions appear in uppercase boldface type. For example, if the action is to enter the **tool** command, this manual presents the instruction as:

ENTER
tool

Abbreviated names

Some of the abbreviated names used in this book follow.

Table 2. Parallel Environment abbreviations

Short Name	Full Name
AIX	Advanced Interactive Executive
CSM	Clusters Systems Management
CSS	communication subsystem
CTSEC	cluster-based security
DPCL	dynamic probe class library
dsh	distributed shell
GUI	graphical user interface
HDF	Hierarchical Data Format
IP	Internet Protocol
LAPI	Low-level Application Programming Interface
MPI	Message Passing Interface
PE	IBM Parallel Environment for AIX

Table 2. Parallel Environment abbreviations (continued)

Short Name	Full Name
PE MPI	IBM's implementation of the MPI standard for PE
PE MPI-IO	IBM's implementation of MPI I/O for PE
POE	parallel operating environment
pSeries	IBM @server pSeries
PSSP	IBM Parallel System Support Programs for AIX
RISC	reduced instruction set computer
RSCT	Reliable Scalable Cluster Technology
rsh	remote shell
RS/6000	IBM RS/6000
SP	IBM RS/6000 SP
STDERR	standard error
STDIN	standard input
STDOUT	standard output

Prerequisite and related information

The Parallel Environment library consists of:

- *IBM Parallel Environment for AIX: Introduction*, SA22-7947
- *IBM Parallel Environment for AIX: Installation*, GA22-7943
- *IBM Parallel Environment for AIX: Messages*, GA22-7944
- *IBM Parallel Environment for AIX: MPI Programming Guide*, SA22-7945
- *IBM Parallel Environment for AIX: MPI Subroutine Reference*, SA22-7946
- *IBM Parallel Environment for AIX: Operation and Use, Volume 1*, SA22-7948
- *IBM Parallel Environment for AIX: Operation and Use, Volume 2*, SA22-7949

To access the most recent Parallel Environment documentation in PDF and HTML format, refer to the IBM @server Cluster Information Center on the Web at:

| **http://publib.boulder.ibm.com/infocenter/clresctr/index.jsp**

Both the current Parallel Environment books and earlier versions of the library are also available in PDF format from the IBM Publications Center Web site located at:

http://www.ibm.com/shop/publications/order/

It is easiest to locate a book in the IBM Publications Center by supplying the book's publication number. The publication number for each of the Parallel Environment books is listed after the book title in the preceding list.

Using LookAt to look up message explanations

LookAt is an online facility that lets you look up explanations for most of the IBM messages you encounter, as well as for some system abends and codes. You can use LookAt from the following locations to find IBM message explanations for Clusters for AIX and Linux®:

- The Internet. You can access IBM message explanations directly from the LookAt Web site:

http://www.ibm.com/eserver/zseries/zos/bkserv/lookat/

- Your wireless handheld device. You can use the LookAt Mobile Edition with a handheld device that has wireless access and an Internet browser (for example, Internet Explorer for Pocket PCs, Blazer, or Eudora for Palm OS, or Opera for Linux handheld devices). Link to the LookAt Mobile Edition from the LookAt Web site.

How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. If you have any comments about this book or any other PE documentation:

- Send your comments by e-mail to: mhvrcfs@us.ibm.com

  Be sure to include the name of the book, the part number of the book, the version of PE, and, if applicable, the specific location of the text you are commenting on (for example, a page number or table number).
- Fill out one of the forms at the back of this book and return it by mail, by fax, or by giving it to an IBM representative.

National language support (NLS)

For national language support (NLS), all PE components and tools display messages that are located in externalized message catalogs. English versions of the message catalogs are shipped with the PE licensed program, but your site may be using its own translated message catalogs. The PE components use the AIX environment variable **NLSPATH** to find the appropriate message catalog. **NLSPATH** specifies a list of directories to search for message catalogs. The directories are searched, in the order listed, to locate the message catalog. In resolving the path to the message catalog, **NLSPATH** is affected by the values of the environment variables **LC_MESSAGES** and **LANG**. If you get an error saying that a message catalog is not found and you want the default message catalog:

ENTER

export NLSPATH=/usr/lib/nls/msg/%L/%N

export LANG=C

The PE message catalogs are in English, and are located in the following directories:

/usr/lib/nls/msg/C

/usr/lib/nls/msg/En_US

/usr/lib/nls/msg/en_US

If your site is using its own translations of the message catalogs, consult your system administrator for the appropriate value of **NLSPATH** or **LANG**. For more information on NLS and message catalogs, see *AIX: General Programming Concepts: Writing and Debugging Programs*.

Summary of changes for Parallel Environment 4.2

This release of IBM Parallel Environment for AIX contains a number of functional enhancements, including:

- Support for POWER3™, POWER4™, and POWER5™ servers running AIX 5L V5.2 or AIX 5L V5.3

- Support for IBM @server p5 servers and the High Performance Switch (HPS) with AIX 5L V5.2 only, and coexistence in a cluster managed by Cluster Systems Management (CSM)
- Remote Direct Memory Access (RDMA) for bulk data copy and transfer, and large contiguous messages, only on the HPS
- Support for striping of messages over multiple adapters attached to the pSeries HPS
- MPI support for 128 tasks per node using shared memory
- Support for LoadLeveler® performance improvements
- Support for up to 8192 tasks in a single job, with improved memory utilization for large jobs
- MPI collectives algorithm and optimization improvements
- MPI shared memory collectives use AIX 5L V5.3 cross-memory attachment enhancements
- Point-to-point messages in shared memory use AIX 5L V5.3 cross-memory attachment enhancements
- MPI/LAPI performance statistics
- The SP Switch is no longer supported
- PE 4.2 is the **last** release of PE that will support Parallel Systems Support Programs for AIX (PSSP), the SP Switch2, and POWER3 servers

Chapter 1. Using the pdbx debugger

This chapter describes the **pdbx** debugger. This debugger extends the **dbx** debugger's line-oriented interface and subcommands. Some of these subcommands, however, have been modified for use on parallel programs. The **pdbx** debugger is a POE application with some modifications on the *home node* to provide a user interface.

Before invoking a parallel program using **pdbx** for interactive debugging, you first need to compile the program and set up the execution environment. See *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment* for more information on the following:

- Compiling the program. Be sure to specify the **-g** flag when compiling the program. This produces an object file with symbol table references needed for symbolic debugging. It is also advisable to not use the optimization option, **-O**. Using the debugger on optimized code may produce inconsistent and erroneous results. For more information on the **-g** and **-O** compiler options, refer to their use on other compiler commands such as **cc** and **xlf**. These compiler commands are described in *AIX 5L Commands Reference* or your online manual pages.
- Copying files to individual nodes. Like **poe**, **pdbx** requires that your application program be available to run on each node in your partition. To support source level debugging, **pdbx** requires the source files to be available as well. You will generally use the same mechanism to make the source files accessible as you used for the application program.
- Setting up the execution environment.

As you read these steps, keep in mind that **pdbx** accepts almost all the option flags that **poe** accepts, and responds to the same environment variables.

Also, throughout this book, keep in mind the following information.

The pSeries or RS/6000 processors of your system are called *processor nodes*. A parallel program executes as a number of individual, but related, *parallel tasks* on a number of your system's processor nodes. The group of parallel tasks is called a *partition*. The processor nodes are connected on the same network, so the parallel tasks of your partition can communicate to exchange data or synchronize execution.

pdbx subcommands

Table 3 on page 2 and Table 4 on page 3 outline the **pdbx** subcommands described in this chapter. Complete syntax information for all these subcommands is also provided under the entry for the **pdbx** command in Appendix A, "Parallel environment tools commands," on page 73.

The debugger supports most of the familiar **dbx** subcommands, as well as some additional **pdbx** subcommands. In **pdbx**, *command context* refers to a setting that controls which task(s) receive the subcommands entered at the **pdbx** command prompt.

pdbx subcommands can either be *context sensitive* or *context insensitive*. The debugger directs context sensitive subcommands to just the tasks in the current command context. Command context has no bearing on context insensitive commands, which control overall debugger behavior, and are generally processed on the home node only. These include subcommands for getting help and other information, and ending a **pdbx** session.

You can set the command context on a single task or a group of tasks as described in “Setting command context” on page 14.

Table 3. Context Insensitive pdbx Subcommands

This subcommand:	**Is used to:**	**For more information see:**
alias [alias_name string]	Set or display aliases.	“Creating, removing, and listing command aliases” on page 28
attach <[all | task_list]>	Attach the debugger to some or all the tasks of a given **poe** job.	“Attach mode” on page 7
detach	Detach **pdbx** from all tasks that were attached. This subcommand causes the debugger to exit but leaves the **poe** application running.	“Exiting pdbx” on page 32
dhelp [dbx_command]	Display a brief list of **dbx** commands or help information about them.	“Accessing help for dbx subcommands” on page 28
group <action> [group_name] [task_list]	Manipulate groups. The actions are **add**, **change**, **delete**, and **list**. To indicate a range of tasks, enter the first and last task numbers, separated by a colon or dash. To indicate individual tasks, enter the numbers, separated by a space or comma.	“Grouping tasks” on page 11
help [subject]	Display a list of **pdbx** commands and topics or help information about them.	“Accessing help for pdbx subcommands” on page 27
on <[group | task]> [command]	Set the command context used to direct subsequent commands to a specific task or group of tasks. This subcommand can also be used to deviate from the command context for a single command without changing the current command context.	“Setting the current command context” on page 14
quit	End a **pdbx** session.	“Exiting pdbx” on page 32
source <cmd_file>	Execute **pdbx** subcommands from a specified file. **Note:** The file may contain context sensitive commands.	“Reading subcommands from a command file” on page 29
tasks [long]	Display information about all the tasks in the partition.	“Displaying tasks and their states” on page 10
unalias alias_name	Remove a command alias specified by the **alias** subcommand.	“Creating, removing, and listing command aliases” on page 28

Table 4. Context Sensitive pdbx Subcommands

This Subcommand:	Is used to:	For more information see:
delete <[event_list | * | all]>	Remove breakpoints and tracepoints set by the **stop** and **trace** subcommands. To indicate a range of events, enter the first and last event numbers, separated by a colon or a dash. To indicate individual events, enter the number(s), separated by a space or comma.	"Deleting pdbx events" on page 22
dbx <dbx_command>	Issue a **dbx** subcommand directly to the **dbx** sessions running on the remote nodes. This subcommand is not intended for casual use. It must be used with caution, because it circumvents the **pdbx** server which normally manages communication between the user and the remote **dbx** sessions. It enables experienced **dbx** users to communicate directly with remote **dbx** sessions, but can cause problems as **pdbx** will have no knowledge of the communication that transpired. **Note:** In addition to the **pdbx** subcommands shown in this table, you can use most of the **dbx** subcommands. The **dbx** subcommands are all context sensitive. The only **dbx** subcommands that you cannot use are **clear**, **detach**, **edit**, **multproc**, **prompt**, **run**, **rerun**, **screen**, and the **sh** subcommand with no arguments.	the online PE manual page for **pdbx**. This manual page also appears in Appendix A, "Parallel environment tools commands," on page 73.
hook	Regain control over an unhooked task.	"Unhooking and hooking tasks" on page 23
list [line_number | line_number, line_number | procedure]	Display lines of the current source file, or of a procedure.	"Displaying source" on page 27
load <program> [program_arguments]	Load a program on each node in the current context. This can only be issued once per task per **pdbx** session. **pdbx** will look for the program in the current directory unless a relative or absolute pathname is specified.	"Loading the partition with the load subcommand" on page 9
print <[expression | procedure]>	Print the value of an expression, or run a procedure and print the return code of that procedure.	"Viewing program variables" on page 24
status [all]	Display a list of breakpoints and tracepoints set by the **stop** and **trace** subcommands in the current context. If "all" is specified, all events, regardless of context are shown.	"Checking event status" on page 23
stop	Set a breakpoint for tasks in the current context. Breakpoints are stopping places in your program that halt execution.	"Setting breakpoints" on page 18
trace	Set a tracepoint for tasks in the current context. Tracepoints are places in your program that, when reached during execution, cause the debugger to print information about the state of the program.	"Setting tracepoints" on page 20
unhook	Unhook a task or group of tasks. Unhooking allows the task(s) to run without intervention from the debugger.	"Unhooking and hooking tasks" on page 23
where	Display a list of active procedures and functions.	"Viewing program call stacks" on page 24
<**Ctrl-c**>	Regain debugger control when some tasks in the current context are running. This causes a **pdbx** subset prompt to be displayed, which allows a subset of the **pdbx** function to be performed.	"Context switch when blocked" on page 16

Starting the pdbx debugger

You can start the **pdbx** debugger in either *normal* mode or *attach* mode. In normal mode your program runs under the control of the debugger. In attach mode you attach to a program that is already running. Certain options and functions are only available in one of the two modes. Since **pdbx** is a source code debugger, some files need to be compiled with the **-g** option so that the compiler provides debug symbols, source line numbers, and data type information.

When the application is started using **pdbx** in normal mode, debugger control of the application is given to the user by default at the first executable source line within the main routine. This is function *main* in C code or the routine defined by the *program* statement in Fortran. In Fortran, if there is no *program* statement, the program name defaults to *main*. If the file containing the main routine is not compiled with **-g** the debugger will exit. The environment variable **MP_DEBUG_INITIAL_STOP** can be set before starting the debugger to manually set an alternate file name and source line where the user initially receives debugger control of the application. Refer to the appendix on POE environment variables and command-line flags in *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*

Normal mode

The way you start the debugger in normal mode depends on whether the program(s) you are debugging follow the SPMD (Single Program Multiple Data) or MPMD (Multiple Program Multiple Data) model of parallel programming. In the SPMD model, the same program runs on each of the nodes in your partition. In the MPMD model, different programs can run on the nodes of your partition.

If you are debugging an SPMD program, you can enter its name on the **pdbx** command line. It will be loaded on all the nodes of your partition automatically. If you are debugging an MPMD program, you will load the tasks of your partition after the debugger is started. **pdbx** will look for the program in the current directory unless a relative or absolute pathname is specified.

ENTER

pdbx [*program* [*program_options*]] [*poe options*] [**-c** *command_file*] [**-d** *nesting_depth*] [**-E** *DebugEnv* [**-E** *DebugEnv*]...] [**-I** *directory* [**-I** *directory*]...] [**-F**] [**-x**]

This starts **pdbx**. If you specified a *program*, it is loaded on each node of your partition and you see the message:

```
0031-504  Partition loaded ...
```

You will then see the pdbx prompt:

```
pdbx(all)
```

The prompt shows the command context `all`. For more information see “Setting command context” on page 14.

ENTER

pdbx -a *poe process id* [*limited poe options*] [**-c** *command_file*] [**-d** *nesting_depth*] [**-I** *directory* [**-I** *directory*]...] [**-F**] [**-x**]

This starts **pdbx** in attach mode. See “Attach mode” on page 7 for more information.

ENTER
: **pdbx -h**

  This writes the **pdbx** usage to STDERR. It includes **pdbx** command line syntax and a description of **pdbx** options.

The options you specify with the **pdbx** command can be program options, POE options, or **pdbx** options listed in Table 5. Program options are those that your application program will understand.

You can use the same command-line flags on the **pdbx** command as you use when invoking a parallel program using the **poe** command. For example, you can override the **MP_PROCS** variable by specifying the number of processes with the **-procs** flag. Or you could use the **-hostfile** flag to specify the name of a host list file. For more information on the POE command-line flags, see *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*

Note: **poe** uses the **PATH** environment variable to find the program, while **pdbx** does not.

After **pdbx** initializes, the **pdbx** command prompt displays to indicate that **pdbx** is ready for a command.

Table 5. Debugger Option Flags (pdbx)

Use this flag:	To:	For example:
-a	Attach to a running **poe** job by specifying its process id. This must be executed from the node where the **poe** job was initiated. When using the debugger in attach mode there are some debugger command line arguments that should not be used. In general, any arguments that control how the partition is set up or specify application names and arguments should not be used.	To attach the **pdbx** debugger to an already running **poe** job. **ENTER** **pdbx -a** <*poe_process_id*>
-c	Read **pdbx** startup commands from the specified *commands_file*. The commands stored in the specified file are executed before command input is accepted from the keyboard. If the **-c** flag is not used, the **pdbx** debug program attempts to read startup commands from the file *.pdbxinit*. To find this file, it first looks in the current directory, and then in the user's home directory. In a **pdbx** session, you can also read commands from a file using the **source** subcommand. "Reading subcommands from a command file" on page 29 describes how to use this subcommand in **pdbx**.	To start the **pdbx** debugger and read startup commands from a file called *start.cmd*: **ENTER** **pdbx -c** *start.cmd*
-d	Set the limit for the nesting of program blocks. The default nesting depth limit is 25. This flag is passed to **dbx** unmodified.	To specify a nesting depth limit: **ENTER** **pdbx -d** *nesting.depth*

Table 5. Debugger Option Flags (pdbx) (continued)

Use this flag:	To:	For example:
-E	This flag can be used to specify an environment variable and its value which will be set for the remote task. The **-E** flag must be specified multiple times to specify multiple environment variables. This flag has no effect when used in combination with the **-a** flag. **Note: poe** sets up some environment variables for the remote task which could be overridden using the **pdbx -E** flag. To resolve this, it may be necessary to check the environment of the remote task with and without the **pdbx -E** flag.	**ENTER** **pdbx -E**
-F	This flag can be used to turn off *lazy reading* mode. Turning lazy reading mode off forces the remote **dbx** sessions to read all symbol table information at startup time. By default, lazy reading mode is on. Lazy reading mode is useful when debugging large executable files, or when paging space is low. With lazy reading mode on, only the required symbol table information is read upon initialization of the remote **dbx** sessions. Because all symbol table information is not read at **dbx** startup time when in lazy reading mode, local variable and related type information will not be initially available for functions defined in other files. The effect of this can be seen with the **whereis** command, where instances of the specified local variable may not be found until the other files containing these instances are somehow referenced.	To start the **pdbx** debugger and read all symbol table information: **ENTER** **pdbx -F**
-h	Write the **pdbx** usage to STDERR then exit. This includes **pdbx** command line syntax and a description of **pdbx** options.	**ENTER** **pdbx -h**
-I (upper case i)	Specify a directory to be searched for an executable's source files. This flag must be specified multiple times to set multiple paths. (Once **pdbx** is running, this list can be overridden on a group or single node basis with the **use** command.)	To add *directory1* to the list of directories to be searched when starting the **pdbx** debugger: **ENTER** **pdbx -I** *dir1* You can add as many directories as you like to the directory list in this way. For example, to add two directories: **ENTER** **pdbx -I** *dir1* **-I** *dir2*
-x	Prevent the **dbx** command from stripping _ (trailing underscore) characters from symbols originating in Fortran source code. This flag allows **dbx** to distinguish between symbols which are identical except for an underscore character, such as xxx and xxx_.	To prevent trailing underscores from being stripped from symbols in Fortran source code: **ENTER** **pdbx -x**

These **pdbx** flags are closely tied to the flags supported by **dbx**. For more information on the option flags described in this table, refer to their use with **dbx** as described in *AIX 5L Commands Reference* and *AIX 5L General Programming Concepts: Writing and Debugging Programs*.

For a listing of **pdbx** subcommands, you can also refer to its online manual page. This manual page also appears in Appendix A, "Parallel environment tools commands," on page 73.

Attach mode

The **pdbx** debugger provides an attach feature, which allows you to attach the debugger to a parallel application that is currently executing. This feature is typically used to debug large, long running, or apparently "hung" applications. The debugger attaches to any subset of tasks without restarting the executing parallel program.

Parallel applications run on the partition managed by **poe**. For attach mode, you must specify the appropriate process identifier (PID) of the **poe** job, so the debugger can attach to the correct application processes contained in that particular job. To get the PID of the **poe** job, enter the following command on the node where **poe** was started:

```
$ ps -ef | grep poe
```

You initiate attach mode by invoking **pdbx** with the **-a** flag and the PID of the appropriate **poe** process:

```
$ pdbx -a <poe PID>
```

For example, if the process id of the **poe** process is `12345` then the command would be:

```
$ pdbx -a 12345
```

After you invoke the debugger in attach mode, it displays a list of tasks you can choose. The paging tool used to display the menu will default to **pg -e** unless another pager is specified by the **PAGER** environment variable.

pdbx starts by showing a list of task numbers that comprise the parallel job. The debugger obtains this information by reading a configuration file created by **poe** when it begins a job step. At this point you must choose a subset of that list to attach the debugger. Once you make a selection and the attach debug session starts, you cannot make additions or deletions to the set of tasks attached to. It is possible to attach a different set of tasks by detaching the debugger and attaching again, then selecting a different set of tasks.

The debugger attaches to the specified tasks. The selected executables are stopped wherever their program counters happen to be, and are then under the control of the debugger. The other tasks in the original **poe** application continue to run. **pdbx** displays information about the attached tasks using the task numbering of the original **poe** application partition.

Note: Since non-threaded and threaded MPI libraries have been combined, all programs now run as threaded programs. When using the debugger, you need to be aware of setting the current running thread. For examples, see the section *Let us attach to the debugger* in the *IBM Parallel Environment for AIX 5L Introduction*.

Attach screen

Figure 1 shows a sample **pdbx** Attach screen.

```
ATTENTION: 0029-9049 The following environment variables have been
ignored since they are not valid when starting the debugger
in attach mode -
  'MP_PROCS'.

To begin debugging in attach mode, select a task or tasks to attach.

Task       IP Addr                Node                PID     Program
0        9.117.8.62          pe02.kgn.ibm.com        23870      ftoc
1        9.117.8.63          pe03.kgn.ibm.com        14908      ftoc
2        9.117.8.64          pe04.kgn.ibm.com        14400      ftoc
3        9.117.8.65          pe05.kgn.ibm.com        13114      ftoc
4        9.117.8.66          pe06.kgn.ibm.com        11330      ftoc
5        9.117.8.67          pe07.kgn.ibm.com        19784      ftoc
6        9.117.8.68          pe08.kgn.ibm.com        19524      ftoc
7        9.117.8.69          pe09.kgn.ibm.com        22086      ftoc

At the pdbx prompt enter the "attach" command followed by a
list of tasks or "all".  (ex. "attach 2 4 5-7" or "attach all")
You may also type "help" for more information or "quit" to exit
the debugger without attaching.

pdbx(none)
```

Figure 1. pdbx Attach screen

The **pdbx** Attach screen contains a list of tasks and, for each task, the following information:

- Task - the task number
- IP - the ip address of the node on which the task/application is running
- Node - the name of the node on which the task/application is running, if available
- PID - the process identifier of the task/application
- Program - the name of the application and arguments, if any.

After initiating attach mode, you can select a set of tasks to attach to. At the command prompt:

ENTER
: **attach all**

OR

ENTER
: **attach** followed by the *task_list* (see "Syntax for task_list" on page 11 for the correct syntax).

It is also possible to use the **quit** or **help** command at this prompt. Any other command will produce an error message. The **quit** command will not kill the application at this point, since the debugger has not been attached as of yet.

Note: When debugging in attach mode, the **load** subcommand is not available. An error message is displayed if an attempt is made to use it.

Other compiling options

pdbx provides substantial information when debugging an executable compiled with the **-g** option. However, you may find it useful to attach to an application not compiled with **-g**. **pdbx** allows you to attach to an application not compiled with **-g**, however, the information provided is limited to a stack trace.

You can also attach **pdbx** to an application compiled with both the **-g** and optimization flags. However, the optimized code can cause some confusion when debugging. For example, when stepping through code, you may notice the line marker points to different source lines than you would expect. The optimization causes this remapping of instructions to line numbers.

Command line arguments

You should not use certain command line arguments when debugging in attach mode. If you do, the debugger will not start, and you will receive a message saying the debugger will not start. In general, do not use any arguments that control how the debugger partition is set up or that specify application names and arguments. You do not need information about the application, since it is already running and the debugger uses the PID of the **poe** process to attach. Other information the debugger needs to set up its own partition, such as node names and PIDs, comes from the configuration file and the set of tasks you select. See Appendix B, "Command line flags for normal or attach mode," on page 147 for a list of command line flags showing which ones are valid in normal and in attach debugging mode.

The information in the appendix is also true for the corresponding environment variables, however **pdbx** ignores the invalid setting. The debugger displays a message containing a list of the variables it ignores, and continues.

For example, if you had **MP_PROCS** set, when the debugger starts in attach mode it ignores the setting. It displays a message saying it ignored **MP_PROCS**, and continues initializing the debug session.

Loading the partition with the load subcommand

Before you can debug a parallel program with the **pdbx** debugger, you need to load your partition. If you specified a program name on the **pdbx** command, it is already loaded on each task of your partition. If not, you need to load your partition using the **load** subcommand. **pdbx** will look for the program in the current directory unless a relative or absolute pathname is specified. The Partition Manager allocates the tasks of your partition when you enter the **pdbx** command. It does this either by connecting to the Resource Manager or by looking to your host list file. The number of tasks in the partition depends on the value of the **MP_PROCS** environment variable (or the value specified on the **-procs** flag) when you enter the **pdbx** command.

The following **pdbx** commands are available before the program is loaded on all tasks:

- alias
- group
- help
- load
- on
- quit

- source
- tasks
- unalias

To load the same executable on all tasks of the partition:	To load separate executables on the partition:
CHECK the **pdbx** command prompt to make sure the command context is on all tasks. The context *all* is the default when you start the **pdbx** debugger, so the prompt should read: `pdbx(all)` If the command context is not set on *all* tasks, reset it. To do this: **ENTER** **on all** Once the command context is on all tasks: **ENTER** **load** *program* [program_options] The specified program is loaded onto all tasks in the partition, and the message "Partition loaded..." displays. The parallel program runs up to the first executable statement and stops. **Note:** The example above has the same effect as putting the program name and options on the command line.	**SET™** the command context before loading each program. For example, say your partition consists of five tasks numbered 0 through 4. To load a program named *program1* on task 0 and a program named *program2* on tasks 1 through 4, you would: **ENTER** **on** *0* The debugger sets the command context on task 0 **ENTER** **load** *program1* [program_options] The debugger loads *program1* on task 0. **ENTER** **group add** *groupa 1-4* The debugger creates a task group named *groupa* consisting of tasks 1 through 4. **ENTER** **on** *groupa* The debugger sets the command context on tasks 1 through 4. **ENTER** **load** *program2* [program_options] The debugger loads *program2* onto tasks 1 through 4, and the message "Partition loaded..." displays. The parallel program runs up to the first executable statement and stops.

Displaying tasks and their states

With the **tasks** subcommand, you display information about all the tasks in the partition. Task state information is always displayed (see Table 6 on page 14 for information on task states). If you specify "long" after the command, it also displays the name, ip address, and job manager number associated with the task.

Following is an example of output produced by the **tasks** and **tasks long** command.

```
pdbx(others) tasks
  0:D     1:D     2:U     3:U     4:R     5:D     6:D     7:R

pdbx(others) tasks long
  0:Debug ready   pe04.kgn.ibm.com                 9.117.8.68      -1
  1:Debug ready   pe03.kgn.ibm.com                 9.117.8.39      -1
  2:Unhooked      pe02.kgn.ibm.com                 9.117.11.56     -1
  3:Unhooked      augustus.kgn.ibm.com             9.117.7.77      -1
  4:Running       pe04.kgn.ibm.com                 9.117.8.68      -1
```

```
5:Debug ready   pe03.kgn.ibm.com                9.117.8.39      -1
6:Debug ready   pe02.kgn.ibm.com                9.117.11.56     -1
7:Running       augustus.kgn.ibm.com            9.117.7.77      -1
```

Grouping tasks

You can set the context on a group of tasks by first using the context insensitive **group** subcommand to collect a number of tasks under a group name you choose. None of these tasks need to have been loaded for you to include them in a group. Later, you can set the context on all the tasks in the group by specifying its group name with the **on** subcommand.

For example, you could use the **group** subcommand to collect a number of tasks (tasks 0, 1, and 2) as a group named *groupa*. Then, to set the context on tasks 0, 1, and 2, you would:

ENTER
: **on** *groupa*

  The debugger sets the command context on tasks 0, 1, and 2.

Another use of the **group** subcommand is to give a name to a task. For example, assume you have a typical master/worker program. Task 0 is the master task, controlling a number of worker tasks. You could create a group named *master* consisting of just task 0. Then, to set the context on the master task you would:

ENTER
: **on** *master*

  The debugger sets the command context on task 0. Entering **on** *master*, therefore, is the same as entering **on** *0*, but would be more meaningful and easier to remember.

The **group** subcommand has a number of actions. You can use it to:
- Create a task group, or add tasks to an existing task group
- Delete a task group, or delete tasks from an existing task group
- Change the name of an existing task group
- List the existing task groups, or list the members of a particular task group.

Syntax for group_name

Provide a group name that is no longer than 32 characters which starts with an alphabetic character, and is followed by any alphanumeric character combination.

Syntax for task_list

To indicate a range of tasks, enter the first and last task numbers, separated by a colon or dash. To indicate individual tasks, enter the numbers, separated by a space or comma.

Note: Group names “all”, “none”, and “attached” are reserved group names. They are used by the debugger and cannot be used in the **group add** or **group delete** commands. However, the group “all” or “attached” can be renamed using the **group change** command, if it currently exists in the debugging session.

Adding a task to a task group

To add a task to a new or already existing task group, use the **add** action of the **group** subcommand. The syntax is:

group add *group_name task_list*

If the specified *group_name* already exists, then the debugger adds the tasks in *task_list* to that group. If the specified *group_name* does not yet exist, the debugger creates it.

The variable *task_list* **can be:**	**For example, to add the following task(s) to** *groupa***:**	**You would ENTER:**	**The following message displays:**
a single task	task 6	**group add** *groupa 6*	`1 task was added to group "groupa".`
a collection of tasks	tasks 6, 8, and 10	**group add** *groupa 6 8 10*	`3 tasks were added to group "groupa".`
a range of tasks	tasks 6 through 10	**group add** *groupa 6:10*	`5 tasks were added to group "groupa".`
a range of tasks	tasks 6 through 10	**group add** *groupa 6-10*	`5 tasks were added to group "groupa".`

Deleting tasks from a task group

To delete tasks from a task group, use the **delete** action of the **group** subcommand. The syntax is:

group delete *group_name* [*task_list*]

The variable *task_list* **can be:**	**For example, to delete the following from** *groupa***:**	**You would ENTER:**	**The following message displays:**
a single task	task 6	**group delete** *groupa 6*	`Task: 6 was successfully deleted from group "groupa".`
a collection of tasks	task 6, 8, and 10	**group delete** *groupa 6 8 10*	`Task: 6 was successfully deleted from group "groupa". Task: 8 was successfully deleted from group "groupa". Task: 10 was successfully deleted from group "groupa".`
a range of tasks	tasks 6 through 10	**group delete** *groupa 6:10*	`Task: 6 was successfully deleted from group "groupa". Task: 7 was successfully deleted from group "groupa". Task: 8 was successfully deleted from group "groupa". Task: 9 was successfully deleted from group "groupa". Task: 10 was successfully deleted from group "groupa".`

The variable *task_list* can be:	For example, to delete the following from *groupa*:	You would ENTER:	The following message displays:

a range of tasks	tasks 6 through 8	**group delete** *groupa 6-8*	`Task: 6 was successfully`
			`deleted from group "groupa".`
			`Task: 7 was successfully`
			`deleted from group "groupa".`
			`Task: 8 was successfully`
			`deleted from group "groupa".`

You can also use the **delete** action of the **group** subcommand to delete an entire task group. For example, to delete the task group *groupa*, you would:

ENTER

group delete *groupa*

The debugger deletes the task group.

Note: The predefined task group *all* cannot be deleted.

Changing the name of a task group

To change the name of an existing task group, use the **change** action of the **group** subcommand. The syntax is:

group change *old_group_name new_group_name*

For example, say you want to change the name of task group *group1* to *groupa*. At the **pdbx** command prompt, you would:

ENTER

group change *group1 groupa*

The following message displays:

```
Group "group1" has been renamed to "groupa".
```

Listing task groups

To list task groups, their members, and task states use the **list** action of the **group** subcommand. The syntax is:

group list [*group_name*]

You can use the list action to:	For example, if you ENTER:	Then:

list all the task groups.	**group list**	The debugger displays a list of all existing task groups and their members. An example of such a list is shown below.
		`pdbx(0) group list`
		
		`allTasks      0:R    1:D    2:D    3:U    4:U    5:D    6:D`
		`              7:D    8:D    9:D   10:D   11:D`
		`evenTasks     0:R    2:D    4:U    6:D    8:D   10:R`
		`oddTasks      1:D    3:U    5:D    7:D    9:D   11:R`
		`master        0:R`
		`workers       1:D    2:D    3:U    4:U    5:D    6:D    7:D`
		`              8:D    9:D   10:R   11:R`

You can use the list action to:	For example, if you ENTER:	Then:
list all the members of a single task group	**group list** *oddTasks*	The debugger displays a list of all the members of task group *oddTasks*. `1:D    3:U    5:D    7:D    9:D    11:R`

When you list tasks, a single letter will follow each task number. The following table represents the state of affairs on the remote tasks. Common states are "debug ready", where **pdbx** commands can be issued, and running, where the application has control and is executing.

Table 6. Task States

This letter displayed after a task number:	Represents:	And indicates that:
N	Not loaded	the remote task has not yet been loaded with an executable.
S	Starting	the remote task is being loaded with an executable.
D	Debug ready	the remote task is stopped and debug commands can be issued.
R	Running	the remote task is in control and executing the program.
X	Exited	the remote task has completed execution.
U	Unhooked	the remote task is executing without debugger intervention.
E	Error	the remote task is in an unknown state.

When thinking about "task states", consider the perspective of the remote tasks which are each running a copy of **dbx**. **pdbx** attempts to coordinate activities in multiple **dbx** sessions. There are times when this is not possible, typically when one or more tasks have not yet stopped. In this case, from a remote task's **dbx** perspective, a **dbx** prompt has not yet been displayed, and your application is still running. Similarly, **pdbx** will not display a **pdbx** prompt until all the remote **dbx** sessions are "debug ready".

Setting command context

You can set the current command context on a specific task or group of tasks so that the debugger directs subsequent context sensitive subcommands to just that task or group. This section also shows how you can temporarily deviate from the current command context you set.

Setting the current command context: When you begin a **pdbx** session, the default command context is set on all tasks. The **pdbx** command prompt always indicates the current command context setting, so it initially reads:

```
pdbx(all)
```

Before you can do an **on** command, you may need to set the thread context to the current running thread, as described in the *IBM Parallel Environment for AIX 5L, Introduction*.

Note: Programs that are not threaded still use threads created by the MPI library.

You can use the **on** subcommand to set the current command context on one task or a group of tasks. The debugger then directs context sensitive subcommands to just the task(s) specified by group or task name.

You can use the **on** subcommand to set the current command context *before* you load your partition. The debugger will only direct context sensitive subcommands to the tasks in the current context. The syntax of the **on** subcommand is:

on {*group_name* | *task_id*}

For example, assume you have a parallel program divided into tasks numbered 0 through 4. To set the current command context on just task 1:

ENTER
: **on** *1*

  The **pdbx** command prompt indicates the new setting of the current command context.

  ```
  pdbx(1)
  ```

You can also use the **on** subcommand to set the current command context on all the tasks in a specified task group. The task group *all* – consisting of all tasks – is automatically defined for you and cannot be deleted. To set the command context back on all tasks, you would:

ENTER
: **on** *all*

  The **pdbx** command prompt shows that the current command context has changed, and that the debugger will now direct context sensitive subcommands to all tasks in the partition.

  ```
  pdbx(all)
  ```

When you switch context using **on** *context_name*, and the new context has at least one task in the “running” state, a message is displayed stating that at least one task is in the “running” state. No **pdbx** prompt is displayed until all tasks in this context are in the “debug ready” state.

When you switch to a context where all tasks are in the “debug ready” state, the **pdbx** prompt is displayed immediately, indicating **pdbx** is ready for a command.

At the **pdbx** subset prompt, **on** *context_name* causes one of the following to happen: either a **pdbx** prompt is displayed; or a message is displayed indicating the reason why the **pdbx** prompt will be displayed at a later time. This is generally because one of the tasks is in “running” state. See “Context switch when blocked” on page 16 for more information.

Temporarily deviating from the current command context: There are times when it is convenient to deviate from the current command context for a single command. You can temporarily deviate from the command context by entering the **on** subcommand with, on the same line, a context sensitive subcommand. The **pdbx** prompt will be presented after all of the tasks in the temporary context have completed the command specified. It is possible, using <**Ctrl-c**> followed by the **back** or the **on** command, to issue further **pdbx** commands in the original context. The syntax is:

on {*group_name* | *task_id*} [*subcommand*]

For example, assume a task group named *groupa* contains tasks 3 through 5. The current command context is on this group. You want to set a breakpoint at line 99 of task 3 only, and then continue directing commands to all three members of *groupa*. One way to do this is to enter the three subcommands shown in the following example. This example shows the **pdbx** command prompt for additional illustration.

```
pdbx(groupa) on 3
pdbx(3) stop at 99
pdbx(3) on groupa
pdbx(groupa)
```

It is easier, however, to temporarily deviate from the current command context.

```
pdbx(groupa) on 3 stop at 99
pdbx(groupa)
```

The context sensitive **stop** subcommand is directed to task 3 only, but the current command context is unchanged. The next command entered at the **pdbx** command prompt is directed to all the tasks in the *groupa* task group.

At a **pdbx** prompt, you cannot use **on** *context_name pdbx_command* if any of the tasks in the specified context are running.

Context switch when blocked

When a task is blocked (there is no **pdbx** prompt), you can press **<Ctrl-c>** to acquire control. This displays the **pdbx** subset prompt `pdbx-subset([group | task])`, and provides a subset of **pdbx** functionality including:

- Changing the current context
- Displaying information about groups/tasks
- Interrupting the application
- Showing breakpoint/tracepoint status
- Getting help
- Exiting the debugger.

You can change the subset of tasks to which context sensitive commands are directed. Also, you can understand more about the current state of the application, and gain control of your application at any time, not just at user-defined breakpoints.

When a **pdbx** subset prompt is encountered, all input you type at the command line is intercepted by **pdbx**. All commands are interpreted and operated on by the home node. No data is passed to the remote nodes and standard input (STDIN) is not given to the application. Most commands in the **pdbx** subset produce information about the application and display the **pdbx** subset prompt. The exceptions are the **halt**, **back**, **on**, and **quit** commands. The **halt**, **back**, and **on** commands cause the **pdbx** prompt to be displayed when all of the tasks in the current context are in "debug ready" state.

The following example shows how the function works. A user is trying to understand the behavior of a program when tasks in the current context hang. This is a four task job with two groups defined called `low` and `high`. `Low` has tasks 0 and 1 while `high` has tasks 2 and 3. A breakpoint is set after a blocking read in task 2, and somewhere else in task 3. Group `high` is allowed to continue, and task 2 has a blocking read that will be satisfied by a write from task 0. Since task 0 is not executing, the job is effectively deadlocked and the **pdbx** prompt will not be displayed. The “effective deadlock” happens because the debugger controls some of the tasks that would otherwise be running. This could be called a debugger induced deadlock.

Using <**Ctrl-c**> allows the debugger to switch to task 0, then step past the write that satisfies the blocking read in task 2. A subsequent switch to group `high` shows task 2.

pdbx subset commands: The following table shows some commands that are uniquely available at the **pdbx** subset prompt, plus other **pdbx** commands that can be used. Certain commands are not allowed. The available commands keep the same command syntax as the **pdbx** subcommands (see “pdbx subcommands” on page 1).

This subset command:	Is used to:	For more information see:
alias [alias_name string]	Set or display aliases.	“Creating, removing, and listing command aliases” on page 28
back	Return to a **pdbx** prompt.	“Returning to a pdbx prompt” on page 18
group <action> [group_name] [task_list]	Manipulate groups. The actions are **add**, **change**, **delete**, and **list**. To indicate a range of tasks, enter the first and last task numbers, separated by a colon or dash. To indicate individual tasks, enter the numbers, separated by a space or comma.	“Grouping tasks” on page 11
halt [all]	Interrupt all tasks in the current context that are running. If “all” is specified, all tasks, regardless of state, are interrupted. This command always returns to a **pdbx** prompt.	“Interrupting tasks” on page 20
help [subject]	Display a list of **pdbx** commands and topics or help information about them.	“Accessing help for pdbx subcommands” on page 27
on <[group | task]>	Set the current context for later subcommands. This command always returns to a **pdbx** prompt.	“Setting command context” on page 14
source <cmd_file>	Execute subcommands stored in a file. **Note:** The file may contain context sensitive commands.	“Reading subcommands from a command file” on page 29
status [all]	Display the trace and stop events within the current context. If “all” is specified, all events, regardless of context, are displayed.	“Checking event status” on page 23
tasks [long]	Display processes (tasks) and their states.	“Displaying tasks and their states” on page 10
quit	Exit the **pdbx** program and kill the application.	“Exiting pdbx” on page 32
unalias alias_name	Remove a previously defined alias.	“Creating, removing, and listing command aliases” on page 28

<Ctrl-c>	Has no effect, except to display the following message:
	`Typing Ctrl-c from the pdbx subset prompt`
	`has no effect.`
	`Use the halt command to interrupt`
	`the application.`
	`Use the quit command to quit pdbx.`
	`Type help then enter to view brief help of`
	`the commands available.`
		“Context switch when blocked” on page 16

Returning to a pdbx prompt: The **back** command causes the pdbx prompt to be displayed, when all the tasks in the current context are in “debug ready” state. You can use the **back** command if you want the application to continue as it was before **<Ctrl-c>** was issued. Also, you can use it if during subset mode all of the nodes are checked into debug ready state, and you want to do normal **pdbx** processing. The **back** command is only valid in **pdbx** subset mode.

It is also possible to return to the **pdbx** prompt using the **on** and the **halt** commands.

Controlling program execution

Like the **dbx** debugger, **pdbx** lets you set breakpoints and tracepoints to control and monitor program execution. *Breakpoints* are stopping places in your program. They halt execution, enabling you to then examine the state of the program. *Tracepoints* are places in the program that, when reached during execution, cause the debugger to print information about the state of the program. An occurrence of either a breakpoint or a tracepoint is called an *event*.

If you are already familiar with breakpoints and tracepoints as they are used in **dbx**, be aware that they work somewhat differently in **pdbx**. The subcommands for setting, checking, and deleting them are similar to their counterparts in **dbx**, but have been modified for use on parallel programs. These differences stem from the fact that they can now be directed to any number of parallel tasks.

This section describes how to:
- Set a breakpoint for tasks in the current context using the **stop** subcommand.
- Use the **halt** subcommand to interrupt tasks in the current context.
- Set a tracepoint for tasks in the current context using the **trace** subcommand.
- Use the **delete** subcommand to remove events for tasks in the current context.
- Use the **status** subcommand to display events set for tasks in the current context.

If you are already familiar with the **dbx** subcommands **stop**, **trace**, **status**, and **delete**, read the following as a discussion of how these subcommands are changed for **pdbx**.

The next few pages should act as an introduction to breakpoints and tracepoints if you are unfamiliar with **dbx**.

Refer to *AIX 5L Commands Reference* and *AIX 5L General Programming Concepts: Writing and Debugging Programs* for more information on subcommands.

Setting breakpoints

The **stop** subcommand sets breakpoints for all tasks in the current context. When all tasks reach some breakpoint, execution stops and you can then examine the state of the program using other **pdbx** or **dbx** subcommands. These breakpoints can be different on each task.

The syntax of this context sensitive subcommand is:

stop if *<condition>*

stop at *<source_line_number>* [**if** <condition>]

stop in <*procedure*> [**if** <condition>]

stop <*variable*> [**if** <condition>]

stop <*variable*> **at** <*source_line_number*>
[**if** <condition>]

stop <*variable*> **in** <*procedure*> [**if** <condition>]

Specifying **stop at** <*source_line_number*> causes the breakpoint to be triggered each time that source line is reached.

Specifying **stop in** <*procedure*> causes the breakpoint to be triggered each time the program counter reaches the first executable source line in the procedure (function, subroutine).

Using the <*variable*> argument to stop causes the breakpoint to be triggered when the contents of the variable changes. This form of breakpoint can be very time consuming. For better results, when possible, further qualify these breakpoints with a *source_line* or *procedure* argument.

Specify the <*condition*> argument using the syntax described by "Specifying expressions" on page 30.

For example, to set a breakpoint **at** line 19 for all tasks in the current context, you would:

ENTER
: **stop at** *19*

  The debugger displays a message reporting the event it has built. The message includes the current context, the event ID associated with your breakpoint, and an interpretation of your command. For example:

  ```
  all:[0] stop at "ftoc.c":19
  ```

  The message reports that a breakpoint was set for the tasks in the task group *all*, and that the event ID associated with the breakpoint is *0*. Notice that the syntax of the interpretation is not exactly the same as the command entered.

Notes:

1. The **pdbx** debugger will not set a breakpoint at a line number in a group context if the group members have different current source files. Instead, the following error message will be displayed.

   ```
   ERROR: 0029-2081 Cannot set breakpoint or tracepoint event in
                    different source files.
   ```

   If this happens, you can either:
   - change the current context so that the **stop** subcommand will be directed to tasks with identical source files.
   - set the same source file for all members of the group using the **file** subcommand.
2. When specifying a variable name on the **stop** subcommand in **pdbx**, it is important to use fully-qualified names as arguments. See "Specifying variables on the trace and stop subcommands" on page 21 for more information.

3. For further details on the **stop** subcommand, refer to its use on the **dbx** command as described in *AIX 5L Commands Reference* and *AIX 5L General Programming Concepts: Writing and Debugging Programs*.

Interrupting tasks

By using the **halt** command, you interrupt all tasks in the current context that are running. This allows the debugger to gain control of the application at whatever point the running tasks happen to be in the application. To a **dbx** user, this is the same as using **<Ctrl-c>**. This command works at the **pdbx** prompt and at the **pdbx** subset prompt. If you specify “all” with the **halt** command, all running tasks, regardless of context, are interrupted.

Note: At a **pdbx** prompt, the **halt** command never has any effect without “all” specified. This is because by definition, at a **pdbx** prompt, none of the tasks in the current context are in “running” state.

The **halt all** command at the **pdbx** prompt affects tasks outside of the current context. Messages at the prompt show the task numbers that are and are not interrupted, but the **pdbx** prompt returns immediately because the state of the tasks in the current context is unchanged.

When using **halt** at the **pdbx** subset prompt, the **pdbx** prompt occurs when all tasks in the current context have returned to “debug ready” state. If some of the tasks in the current context are running, a message is presented.

Setting tracepoints

The **trace** subcommand sets tracepoints for all tasks in the current context. When any task reaches a tracepoint, it causes the debugger to print information about the state of the program for that task.

The syntax of this context sensitive subcommand is:

trace [**in** <*procedure*>] [**if** <condition>]

trace <*source_line_number*> [**if** <condition>]

trace <*procedure*> [**in** <*procedure*>]
[**if** <condition>]

trace <*variable*> [**in** <*procedure*>]
[**if** <condition>]

trace <*expression*> **at** <*source_line_number*>
[**if** <condition>]

Specifying **trace** with no arguments causes trace information to be displayed for every source line in your program.

Specifying **trace** <*source_line_number*> causes the tracepoint to be triggered each time that source line is reached.

Specifying **trace** [**in** <*procedure*>] causes the tracepoint to be triggered each time your program executes a source line within the procedure (function, subroutine).

Using the <*variable*> argument to trace causes the tracepoint to be triggered when the contents of the variable changes. This form of tracepoint can be very time consuming. For better results, when possible, further qualify these tracepoints with a *source_line_number* or *procedure* argument.

Specify the <*condition*> argument using the syntax described by “Specifying expressions” on page 30.

The **trace** subcommand prints tracing information for a specified *procedure*, *function*, *sourceline*, *expression*, *variable*, or *condition*. For example, to set a tracepoint for the variable *foo* at line 21 for all tasks in the current context, you would:

ENTER

trace *foo* **at** *21*

The debugger displays a message reporting the event it has built. The message includes the current context, the event ID associated with your tracepoint, and an interpretation of your command. For example:

```
all:[1] trace foo at "bar.c":21
```

This message reports that the tracepoint was set for the tasks in the task group *all*, and that the event ID associated with the tracepoint is *1*. Notice that the syntax of the interpretation is not exactly the same as the command entered.

Notes:

1. The **pdbx** debugger will not set a tracepoint at a line number in a group context if the group members have different current source files. Instead, the following error message will be displayed.

   ```
   ERROR: 0029-2081 Cannot set breakpoint or tracepoint event in
                    different source files.
   ```

   If this happens, you can either:

   - change the current context so that the **trace** subcommand will be directed to tasks with identical source files.
   - set the same source file for all members of the group using the **file** subcommand.
2. When specifying a variable name on the **trace** subcommand in **pdbx**, it is important to use fully-qualified names as arguments. See “Specifying variables on the trace and stop subcommands” for more information.
3. For further detail on the **trace** subcommand, refer to its use on the **dbx** command as described in *AIX 5L Commands Reference*

Specifying variables on the trace and stop subcommands

When specifying a variable name as an argument on either the **stop** or **trace** subcommand, you should use fully-qualified names. This is because, when the **stop** or **trace** subcommand is issued, the tasks of your program could be in different functions, and the variable name may resolve differently depending on a task’s position.

For example, consider the following SPMD code segment in *myfile.c*. It is running as two parallel tasks – task 0 and task 1. Task 0 is in *func1* at line 4, while task 1 is in *func2* at line 9.

```
1  int i;
2  func1()
3  {
4      i++;
5  }
6  func2()
```

```
7  {
8      int i;
9      i++;
10  }
```

To display the full qualification of a given variable, you use the **which** subcommand. For example, to display the full qualification of the variable *i* if the current context is *all*:

ENTER

which *i*

The **pdbx** debugger displays the full qualification of the variable specified.

`0:@myfile.i`	(from line 1 of previous example)
`1:@myfile.func2.i`	(from line 8 of previous example)

Because the tasks are at different lines, issuing the following **stop** command would set a different breakpoint for each task:

stop if (*i* == *5*)

The debugger would display a message reporting the event it has built.

```
all:[0] stop if (i == 5)
```

The *i* for task 0, however, would represent the global variable (*@myfile.i*) while the *i* for task 1 would represent the local variable *i* declared within *func2* (*@myfile.func2.i*). To specify the global variable *i* without ambiguity on the **stop** subcommand, you would:

ENTER

stop if (*@myfile.i* **==** *5*)

The debugger reports the event it has built.

```
all:[0] stop if (@myfile.i == 5)
```

Deleting pdbx events

The **delete** subcommand removes events (breakpoints and tracepoints) of the specified **pdbx** event numbers. To indicate a range of events, enter the first and last event numbers, separated by a colon or dash. To indicate individual events, enter the numbers, separated by a space or comma. You can specify " * ", which deletes all events that were created in the current context. You can also specify "all", which deletes all events regardless of context. The syntax of this context sensitive subcommand is:

delete [*event_list* | * | **all**]

The event number is the one associated with the breakpoint or tracepoint. This number is displayed by the **stop** and **trace** subcommands when an event is built. Event numbers can also be displayed using the **status** subcommand. The output of the status command shows the creating context as the first token on the left before the colon.

Event numbers are unique to the context in which they were set, but not globally unique. Keep in mind that, in order to remove an event, the context must be on the appropriate task or task group, except when using the "all" keyword. For example, say the current context is on task 1 and the output of the **status** subcommand is:

```
1:[0] stop in celsius
all:[0] stop at "foo.c":19
all:[1] trace "foo.c":21
```

To delete all these events, you would do one of the following:

ENTER **on** *1*

delete *0*

on *all*

delete *0,1*

OR

ENTER **on** *1*

delete *0*

on *all*

delete *

OR

ENTER **delete** *all*

Checking event status

A list of **pdbx** events can be displayed using the **status** subcommand. You can specify "all" after this command to list all events (breakpoints and tracepoints) that have been set in all groups and tasks. This is valid at the **pdbx** prompt and the **pdbx** subset prompt.

The following shows examples of **status**, **status all**, and incorrect syntax with different breakpoints set on three different groups and two tasks.

```
pdbx(all) status
all:[0] stop at "test/vtsample.c":60

pdbx(all) status all
1:[0] stop in main
2:[0] stop in mpl_ring
all:[0] stop at "test/vtsample.c":60
evenTasks:[0] stop at "test/vtsample.c":58
oddTasks:[0] stop at "test/vtsample.c":56

pdbx(all) status woops
0029-2062 The correct syntax is either 'status' or 'status all'.
```

Because the **status** command (without "all" specified) is context sensitive, it will not display status for events outside the context.

Unhooking and hooking tasks

The **unhook** subcommand lets you unhook a task so that it executes without intervention from the debugger. This subcommand is context sensitive and similar to the **detach** subcommand in **dbx**. The important difference is that you can regain control over a task that has been unhooked, while you cannot regain control over one that has been detached. To regain control over an unhooked task, use the **hook** subcommand. **Detach** is not supported in **pdbx**.

To better understand the **hook** and **unhook** subcommands, consider the following example. You are debugging a typical master/worker program containing many blocking sends and receives. You have created two task groups. One – named *workers* – contains all the worker tasks, and the other – named *master* – contains the master task. You would like to manipulate the master task and let the worker tasks process without debugger interaction. This would save you the bother of switching the command context back and forth between the two task groups.

Since the **unhook** subcommand is context sensitive, you must first set the context on the *workers* task group using the **on** subcommand. At the **pdbx** command prompt:

ENTER
: **on** *workers*

  The debugger sets the command context on the task group *workers*.

ENTER
: **unhook**

  The debugger unhooks the tasks in the task group *workers*.

The worker tasks are still indirectly affected by the debugger since they might, for example, have to wait on a blocking receive for a message from the master task. However, they do execute without any direct interaction from the debugger. If you later wish to reestablish control over the tasks in the *workers* task group, you would, assuming the context is on the *workers* task group:

ENTER
: **hook**

  The debugger hooks any unhooked task in the current command context.

Note: The **hook** subcommand is actually an interrupt. When you interrupt a blocking receive, you cause the request to fail. If the program does not deal with an interrupted receive, then data loss may occur.

Examining program data

The following section explains the **where**, **print**, and **list** subcommands for displaying and verifying data.

Viewing program call stacks

The **where** subcommand displays a list of active procedures and functions.

The syntax of this context sensitive subcommand is:

where

To view the stack trace, issue the **where** command. The following stack trace was encountered after halting task 1. You can see that the main routine at line 144 has issued an **mpi_recv()** call.

```
pdbx(1) where
read(??, ??, ??) at 0xd07b5ce0
readsocket() at 0xd07542f4
kickpipes() at 0xd0750e14
mpci_recv() at 0xd076032c
_mpi_recv() at 0xd0700e2c
MPI__Recv() at 0xd06ffab8
mpi__recv() at 0xd03c4474
main(), line 144 in "send1.f"
```

Viewing program variables

The **print** subcommand does either of the following:

- Prints the value of a list of expressions, specified by the *expression* parameters.

- Executes a procedure, specified by the *procedure* parameter, and prints the return value of that procedure. Parameters that are included are passed to the procedure.

The syntax of this context sensitive subcommand is:

print *expression* ...

print *procedure* ([*parameters*])

See "Specifying expressions" on page 30 for a description of valid expressions.

Following are some examples of printing portions of a two dimensional array of *floats* in a c program which is running on two nodes.

To display the type of array ff, enter:

```
pdbx(all) whatis ff
  0:float ff[10][10];
  1:float ff[10][10];
```

We can see the differences in the array values across the two nodes.

To show elements 4 through 7 of rows 2 and 3, enter:

```
pdbx(all) print ff[2..3][4..7]
  0:[2][4] = 30.0000076
  0:[2][5] = 42.0
  0:[2][6] = 0.0
  0:[2][7] = -3.52516241e+30
  0:[3][4] = -3.54361545e+30
  0:[3][5] = -3.60971468e+30
  0:[3][6] = 2.68063283e-09
  0:[3][7] = 4.65661287e-10
  0:
  1:[2][4] = -1.60068157e+10
  1:[2][5] = 0.0
  1:[2][6] = 0.0
  1:[2][7] = -3.52516241e+30
  1:[3][4] = -3.54361545e+30
  1:[3][5] = -3.60971468e+30
  1:[3][6] = 2.63675126e-09
  1:[3][7] = 1.1920929e-07
  1:
```

The same results as above could be achieved by entering:

```
print ff(2..3,4..7)
```

The array ff is being processed within a loop with loop counters i and j. The following demonstrates printing multiple variables and using program variables to specify the array elements.

```
pdbx(all) print "i is:", i, "\tj is:", j, "\n", ff[i][j..j+1]
  1:i is: 0     j is: 1
  1: [0][1] = -3.54331806e+30
  1:[0][2] = 4.40487202e-10
  1:
  0:i is: 2     j is: 6
  0: [2][6] = 0.0
  0:[2][7] = -3.52516241e+30
  0:
```

Following are some examples which display the elements of an array of *structs*:

The command **whatis** here is used to show that the type of the variable `tree` is an array size 4 of `wood_attr_t`'s.

```
pdbx(0) whatis tree
  0:wood_attr_t tree[4];
```

Here the **whatis** command shows that `wood_attr_t` is a `typedef` for the listed structure.

```
pdbx(0) whatis wood_attr_t
  0:typedef struct {
  0:    int max_age;
  0:    int max_size;
  0:    int is_hard_wood;
  0:} wood_attr_t;
```

This **whatis** command shows that `this_tree` is a `wood_attr_t` ptr.

```
pdbx(0) whatis this_tree
  0:wood_attr_t *this_tree;
```

To display the elements of the first three entries in the tree array, enter:

```
pdbx(0) print tree[0..2]
  0:[0] = (max_age = 150, max_size = 120, is_hard_wood = 0)
  0:[1] = (max_age = 250, max_size = 150, is_hard_wood = 1)
  0:[2] = (max_age = 200, max_size = 125, is_hard_wood = 0)
  0:
```

To display the element `max_size` of entry 1 of the `tree` array, enter:

```
pdbx(0) p tree[1].max_size
  0:150
```

To display the entry that `this_tree` is pointing to, enter:

```
pdbx(0) p *this_tree
  0:(max_age = 200, max_size = 125, is_hard_wood = 0)
```

To display just the `max_size` of the entry that `this_tree` is pointing to, enter:

```
pdbx(0) p this_tree->max_size
  0:125
```

Following are some examples of displaying elements of a two dimensional array of *reals* in a Fortran program:

To take a look at the type of `var43`:

```
pdbx(all) whatis var43
 real*4  var43(4,3)
```

To display the entire array `var43`, enter:

```
pdbx(all) print var43
(1,1)   11.0
(2,1)   21.0
(3,1)   31.0
(4,1)   41.0
(1,2)   12.0
(2,2)   22.0
(3,2)   32.0
(4,2)   42.0
(1,3)   13.0
(2,3)   23.0
(3,3)   33.0
(4,3)   43.0
```

To display a portion of the array `var43`, enter:

```
pdbx(all)  print var43(1..2, 2..3)
(1,2) = 12.0
(2,2) = 22.0
(1,3) = 13.0
(2,3) = 23.0
```

Refer to *AIX 5L General Programming Concepts: Writing and Debugging Programs* for more information on expression handling.

Displaying source

The **list** subcommand displays a specified number of lines of the source file. The number of lines displayed is specified in one of two ways:

Tip: Use **on** <*task*> **list**, or specify the ordered standard output option.

- By specifying a procedure using the *procedure* parameter.

  In this case, the **list** subcommand displays lines starting a few lines before the beginning of the specified procedure and until the list window is filled.
- By specifying a starting and ending source line number using the *sourceline-expression* parameter.

  The *sourceline-expression* parameter should consist of a valid line number followed by an optional + (plus sign), or − (minus sign), and an integer. In addition, a *sourceline* of $ (dollar sign) can be used to denote the current line number. A *sourceline* of @ (at sign) can be used to denote the next line number to be listed.

  All lines from the first line number specified to the second line number specified, inclusive, are then displayed, provided these lines fit in the list window.

  If the second source line is omitted, 10 lines are printed, beginning with the line number specified in the *sourceline* parameter.

  If the **list** subcommand is used without parameters, the default number of lines is printed, beginning with the current source line. The default is 10.

  To change the number of lines to list by default, set the special debug program variable, *$listwindow*, to the number of lines you want. Initially, *$listwindow* is set to 10.

The syntax of this context sensitive subcommand is:

list [*procedure* | *sourceline-expression*[, *sourceline-expression*]]

Other key features

Some other features offered by **pdbx** include the following subcommands:

- **help**
- **dhelp**
- **alias**
- **source**

Also, this section includes information about how to specify expressions for the **print**, **stop**, and **trace** commands.

Accessing help for pdbx subcommands

The **help** command with no arguments displays a list of **pdbx** commands and topics about which detailed information is available.

If you type "help" with one of the **help** commands or topics as the argument, information will be displayed about that subject.

The syntax of this context insensitive command is:

help [*subject*]

Accessing help for dbx subcommands

The **dhelp** command with no arguments displays a list of **dbx** commands about which detailed information is available.

If you type "dhelp" with an argument, information will be displayed about that command.

Note: The partition must be loaded before you can use this command, because it invokes the **dbx help** command. It is also required that a task be in "debug ready" state to process this command. After the program has finished execution, the **dhelp** command is no longer available.

The syntax of this context insensitive command is:

dhelp [**dbx_command**]

Creating, removing, and listing command aliases

The **alias** subcommand specifies a command alias. You could use it to reduce the amount of typing needed, or to create a name more easily remembered. The syntax of this context insensitive subcommand is:

alias **[***alias_name* **[***alias_string***]]**

For example, assume that you have organized all tasks into two convenient groups – *master* and *workers*. During the execution of a program, you need to switch the command context back and forth between these two groups. You could save yourself some typing by creating one alias for *on workers* and one for *on master*. At the **pdbx** command prompt, you would:

ENTER **alias** *mas on master*
alias *wor on workers*

Now to set the command context on the task group *master*, all you have to do is:

ENTER
mas

Likewise, you can now enter **wor** instead of **on** *workers*.

In addition to any aliases you create, there are a number of aliases supplied by **pdbx** when the partition is loaded. To display the list of all existing aliases, use the **alias** subcommand with no parameters. At the **pdbx** command prompt:

ENTER
alias

The debugger displays a list of existing aliases. The example listing below shows all the default aliases provided by **pdbx**, as well as the two aliases – *mas* and *wor* – created in the previous example.

```
active              tasks
c                   cont
ca                  condattr
cv                  condition
d                   delete
h                   help
j                   status
l                   list
m                   map
ma                  mutexattr
mt                  mutex
n                   next
p                   print
pa                  attr
pt                  pthread
q                   quit
ra                  rwlockattr
rw                  rwlock
s                   step
st                  stop
t                   where
th                  pthread
thread              pthread
threads             pthread
x                   registers
mas                 on masters
wor                 on workers
```

Any aliases you create are not saved between **pdbx** sessions. You can also remove command aliases using the **unalias** subcommand. The syntax of this context insensitive subcommand is:

unalias *alias_name*

For example, to remove the alias *mas* defined above, you would:

ENTER **unalias** *mas*

Note: You can create, remove, and list command aliases as soon as you start the debugger. The partition does not need to be loaded.

Reading subcommands from a command file

The **source** subcommand enables you to read a series of subcommands from a specified command file. The syntax of this context-insensitive subcommand is:

source *command_file*

The *command_file* should reside on the home node, and can contain any of the subcommands that are valid on the **pdbx** command line. For example, say you have a commands file named *myalias* which contains a number of command alias settings. To read its commands:

ENTER **source** *myalias*

The debugger reads the commands listed in *myalias* as if they had each been entered at the command line.

Notes:

1. You can also read commands from a file when starting the debugger. This is done using the **-c** flag on the **pdbx** command, or via a *.pdbxinit* file, as described in Table 5 on page 5. The *.pdbxinit* file would be a great way to

automatically create your common aliases. When using a *.pdbxinit* file or the **-c** flag, you need to keep in mind that only a limited set of commands are supported until the partition is loaded.

2. STDIN cannot be included in a command file.

Specifying expressions

Expressions are commonly used in the **print** command, and when specifying conditions for the **stop** or **trace** command.

You can specify conditions with a subset of C syntax, with some Fortran extensions. The following operators are valid:

Arithmetic Operators

+ — Addition

- — Subtraction

- — Negation

* — Multiplication

/ — Floating point division

div — Integer division

mod — Modulo

exp — Exponentiation

Relational and Logical Operators

< — Less than

> — Greater than

<= — Less than or equal to

>= — Greater than or equal to

== — Equal to

= — Equal to

!= — Not equal to

< > — Not equal to

|| — Logical OR

or — Logical OR

&& — Logical AND

and — Logical AND

Bitwise Operators

bitand — Bitwise AND

| — Bitwise OR

xor — Bitwise exclusive OR

~ — Bitwise complement

<< — Left shift

>> Right shift

Data Access and Size Operators

[] Array element

() Array element

***** Indirection or pointer dereferencing

& Address of a variable

. Member selection for structures and unions

. Member selection for pointers to structures and unions

-> Member selection for pointers to structures and unions

sizeof
Size in bytes of a variable

Miscellaneous Operators

() Operator grouping

(Type)Expression
Type cast

Type(Expression)
Type cast

Expression\Type
Type cast

Other important notes on pdbx

Initial breakpoint

The initial automatic breakpoint, which is set by default at function main, for **pdbx** can be redefined by the environment variable **MP_DEBUG_INITIAL_STOP**. See the manual page for the **pdbx** command in Appendix A, "Parallel environment tools commands," on page 73 for more information.

Overloaded symbols

While **pdbx** recognizes function names, it is the combination of a function's name and its parameters, or the function name and the shared object it resides in, that uniquely identify it to **pdbx**. When encountering ambiguous functions, **pdbx** issues the Select menu, which lets the user choose the desired instance of the function.

The Select menu looks like this:

```
pdbx(all) stop in f1
1.ambig.f1(double)
2.ambig.f1(float)
3.ambig.f1(char)
4.ambig.f1(int)
Select one or more of [1 - 4]:
```

The **whatis** subcommand can be used to determine whether or not a function is ambiguous. If **whatis** returns more than one function definition for a given symbol, **pdbx** will consider it ambiguous.

There are a few restrictions for the **pdbx** select menu:

- All tasks in the context must have an identical view of the ambiguous function because **pdbx** will only present one menu to the user that covers all tasks. As a

result, you may need to create additional groups. The view of the ambiguous function is determined by the result of the **whatis** subcommand. In the example above, *whatis f1* should have returned the same result on all tasks, in order to proceed.
- The **hook** subcommand will not restore the set of events generated by the Select menu.
- The **trace** and **print** subcommands do not support ambiguous functions within complex expressions. For example, simple expressions are always allowed:

```
trace myfunc

print myfunc(parm1, parm2)
```

but complex expressions are not allowed when a function (myfunc) is ambiguous:

```
trace myvar-myfunc(parm1, parm2)

print myvar*myfunc(parm1)
```

Exiting pdbx

It is possible to end the debug session at any time using either the **quit** subcommand, or the **detach** subcommand if debugging in attach mode.

To end a debug session in normal mode:

ENTER
quit

This returns you to the shell prompt.

To end a debug session in attach mode, you can choose either **quit** or **detach**. Quitting causes the debugger and all the members of the original **poe** application partition to exit. Detaching causes only the debugger to exit and leaves all the tasks running.

ENTER
quit

The debugger session ends, along with the **poe** application partition tasks.

OR

ENTER
detach

The debugger session ends. All tasks have been detached, but stay running.

Note: You can enter the **quit** and **detach** subcommands from either the **pdbx** prompt or **pdbx** subset prompt.

Choosing **detach** causes **pdbx** to exit, and allows the program to which you had attached to continue execution if it hasn't already finished. If this program has finished execution, and is part of a series of job steps, then detaching allows the next job step to be executed.

If instead you want to exit the debugger and end the program, choose **quit** as described above.

Chapter 2. Analyzing program performance using the PE Benchmarker toolset

This chapter describes the tools and utilities of the PE Benchmarker toolset. You can use these tools to collect and analyze program event trace or hardware performance data. Specifically, this chapter describes:

- the Performance Collection Tool (PCT) for collecting MPI traces or hardware/operating system profiles.
- a set of utilities for converting AIX trace records output by the PCT into a format that can be analyzed within third party tools or other utilities that IBM supplies.
- the Profile Visualization Tool (PVT) for analyzing hardware/operating system profiles collected by the PCT.

What is the PE Benchmarker?

The PE Benchmarker is a suite of applications and utilities that you can use to analyze the performance of programs run within the IBM Parallel Environment for AIX. The PE Benchmarker suite consists of:

- **the Performance Collection Tool (PCT)**. This tool enables you to collect either MPI and user event data or hardware and operating system profiles for one or more application processes (or ″tasks″). This tool is built on dynamic instrumentation technology, the *Dynamic Probe Class Library* (*DPCL*). Unlike more traditional tools for collecting message-passing and other performance information, the PCT, because it is built on DPCL, enables you to insert and remove instrumentation probes into the target application while the target application is running. More traditional tools require the application to be instrumented through compilation or linking. This often results in more instrumentation being inserted into the application than is actually needed, and so such tools are more likely to create situations in which the instrumented version of the application is no longer representative of the actual, uninstrumented, version of the application. Since the PCT enables you to make the decision of what data is collected at run time, this typically results in a more acceptable intrusion cost of the instrumentation. What's more, the files output by the PCT are output on each machine running instrumented processes rather than on a single, centralized, machine. This means that your analysis can be efficiently scaled to collect information on a large number of processes running on a large number of nodes.

  Note: The Dynamic Probe Class Library is no longer a part of the IBM PE for AIX licensed program. DPCL is now available as an open source offering that supports PE. For more information on the DPCL open source project go to the URL **http://dpcl.sourceforge.net**.

  If you have identified a problem with the DPCL software, please report that problem to the DPCL team by sending an email to **dpcl-user@lists.sourceforge.net** describing the problem you are having.
- **a set of Unified Trace Environment (UTE) utilities**. When you collect MPI and user event traces using the PCT, the collected information is saved, on each machine running instrumented processes, as a standard AIX event trace file. The UTE utilities enable you to convert one or more of these AIX trace files into UTE

interval files. While an AIX event trace file has a time stamp indicating the point in time when an event occurred, UTE interval files take this information to also determine how long an event lasts before encountering the next event. Because they include this duration information, UTE interval files are easier to visualize than traditional AIX event trace files.

The libTraceInput.so library, is used by the traceTOslog2 utility, available from Argonne National Laboratory, to convert UTE interval files to the slog2 file format used by the latest version of Jumpshot, also available from Argonne National Laboratory. The traceTOslog2 utility can be obtained using the URL http://www-unix.mcs.anl.gov/perfvis/download/index.htm#slog2sdk. The latest version of Jumpshot can be obtained using the URL http://www-unix.mcs.anl.gov/perfvis/software/viewers/index.htm#Jumpshot-4.

The UTE utilities are:

– the **uteconvert** utility which converts AIX event trace records into UTE interval trace files.

– the **utemerge** utility which merges multiple UTE interval files into a single UTE interval file.

– the **utestats** utility which generates statistics tables from UTE interval files.

– the **traceTOslog2.so** library which is used by the traceTOslog2 utility provided by Argonne National Laboratory to convert UTE interval files to the SLOG2 file format used when viewing MPI traces with the current version of Jumpshot.

– the **slogmerge** utility which converts and merges UTE interval files into a single SLOG file for analysis with the previous version of Argonne National Laboratory's Jumpshot tool. IBM recommends that you use the traceTOslog2 utility to convert UTE interval files to SLOG2 format and that you use the current version of Jumpshot for viewing the SLOG2 files.

- **the Profile Visualization Tool (PVT)**. When you collect hardware and operating system profiles using the PCT, the collected profile information is saved, on each machine running instrumented processes, as netCDF (network Common Data Form) files. The PVT can read netCDF files and summarize the profile information in reports.

The following figure illustrates how the various tools in the PE Benchmarker toolset work together to enable you to analyze the performance of programs run within the IBM AIX Parallel Environment. Please note that Jumpshot is not part of the PE Benchmarker toolset, but is instead a public domain tool developed at Argonne National Laboratory. It is shown in the figure below, because PE Benchmarker provides the **traceTOslog2** utility for converting UTE files into the SLOG2 format required by Jumpshot.

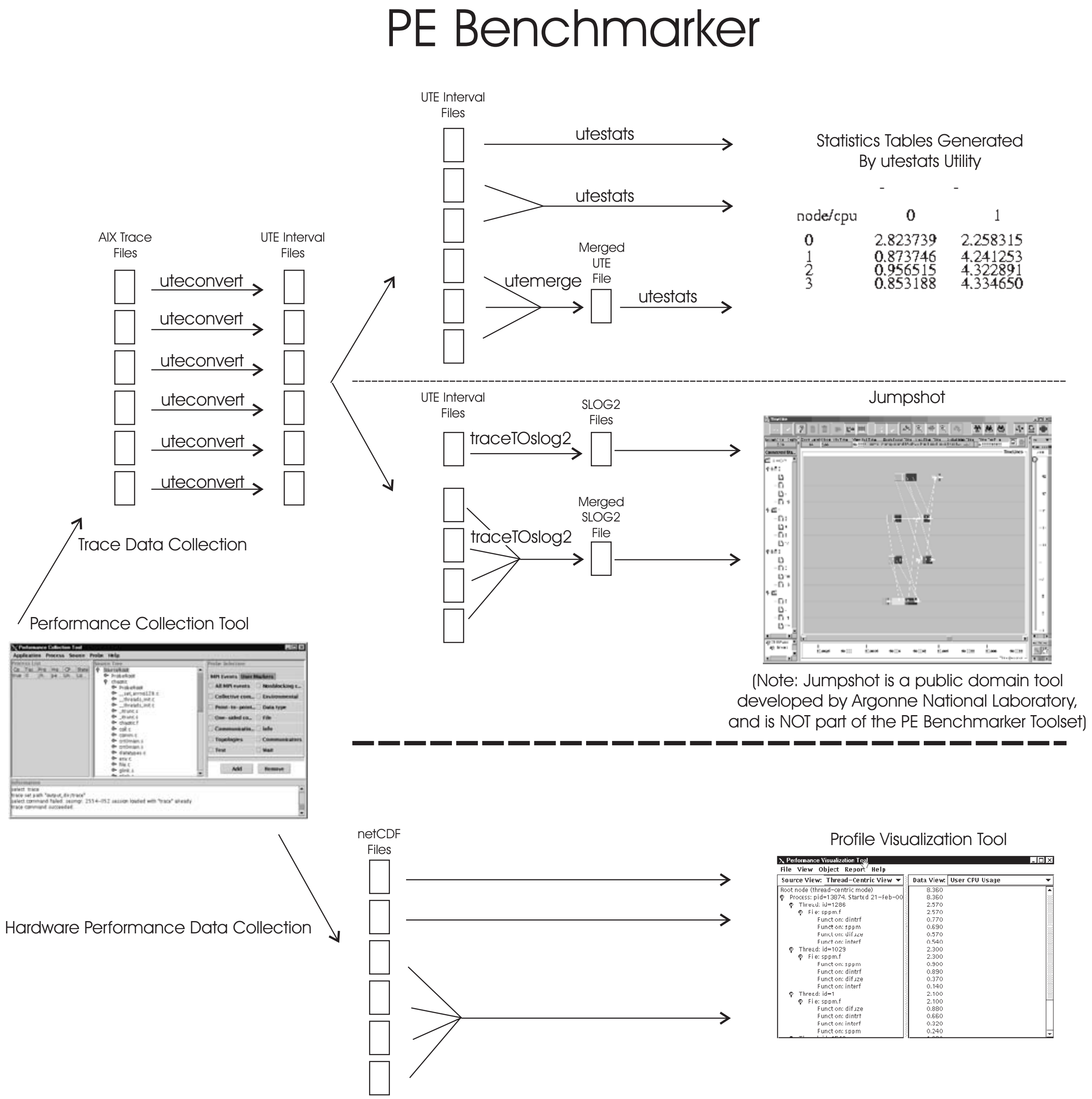


Figure 2. Overview of the PE Benchmarker Toolset

The preceding figure illustrates the procedure for collecting and analyzing data using the PE Benchmarker toolset. This procedure starts with the PCT. When using the PCT, you must select the type of data you are collecting — either MPI and user event trace data or hardware and operating system performance data. You use the PCT to connect to existing processes, or start processes running (which also connects to the processes). By ″connect to processes″ we mean the PCT establishes a communication connection that enables it to control the process' execution (suspend, resume, and terminate the process), and also instrument the process with data collection probes. Data files containing the collected information will be generated on each machine running at least one instrumented process. The format of the files generated depends on the type of data you are collecting.

- If you are collecting MPI and user event trace data, standard AIX trace files will be generated. You will first need to take the AIX trace files output by the PCT and convert them, using the **uteconvert** utility, into UTE interval files. If you want to view statistical tables of the information contained in the UTE interval files, you can use the **utestats** utility. You can optionally merge multiple UTE files into a single UTE file using the **utemerge** utility before using the **utestats** utility to generate the statistical tables. If you instead want to view the information contained in the UTE interval files graphically, you can convert them into SLOG2 files which are readable by Argonne National Laboratory's Jumpshot tool. To convert UTE interval files into SLOG2 files, you use the **traceTOslog2** utility. The **traceTOslog2** utility can convert a single UTE interval file into a single SLOG2 file, or it can convert multiple UTE interval files into a single, merged, SLOG2 file.
- If you are collecting hardware performance data, netCDF files will be generated. You can use the PVT to generate graphs and reports of the information contained in the netCDF files.

Using the Performance Collection Tool

This section describes how to collect MPI and user event traces or hardware and operating system profiles for a particular serial or POE program's run. It describes how you can use the PCT's graphical user interface or command-line interface to:

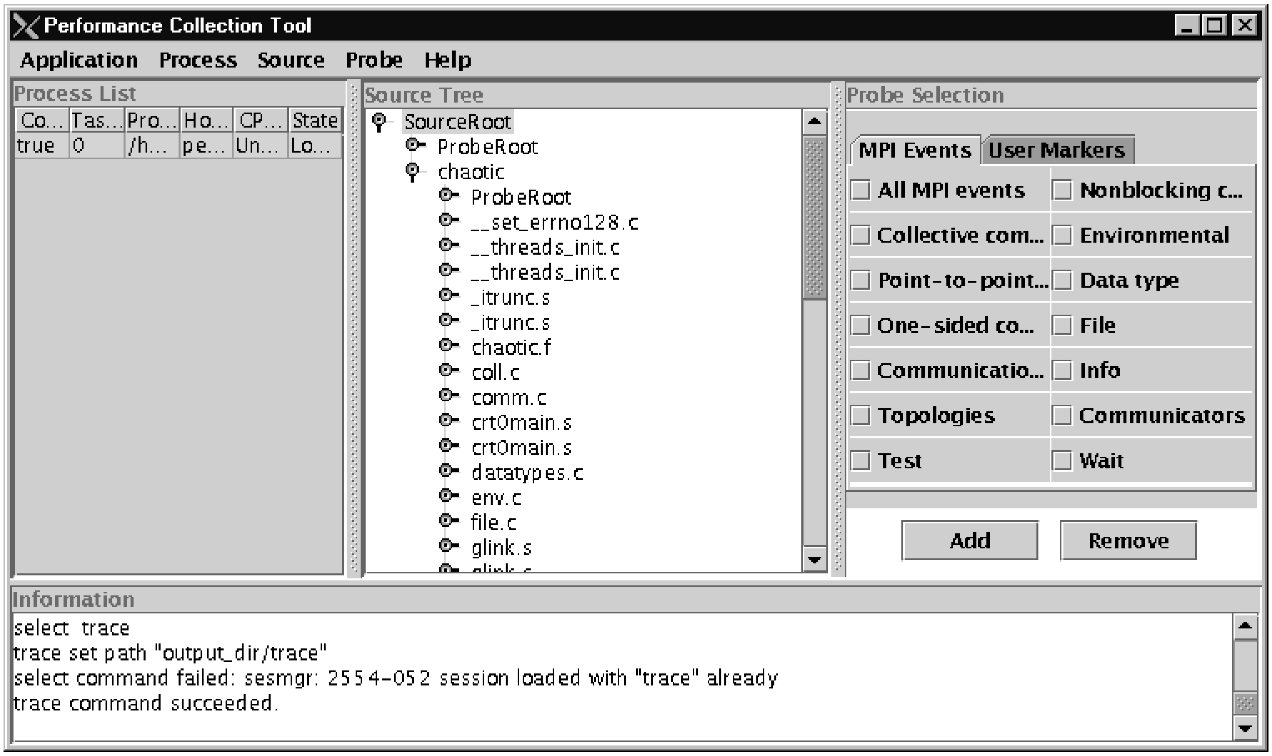
- connect to a running application, or (if the application you want to examine is not already running) load an application and connect to it.
- select the type of data to collect (either MPI and user event traces, or hardware and operating system profiles).
- start and stop execution of the target application.
- install performance collection probes into the target application to collect the MPI, user event trace, or hardware profile information.
- remove the performance collection probes from the target application when you are through collecting the performance data.
- Disconnect from, or terminate, the target application processes.

For information on the tool's graphical user interface, refer to "Using the Performance Collection Tool's graphical user interface." For information on the tool's command-line interface, refer to "Using the Performance Collection Tool's command-line interface" on page 40.

Using the Performance Collection Tool's graphical user interface

This section describes how you can use the PCT's graphical user interface to collect either MPI and user event traces, or hardware and operating system profiles. This section begins with a brief overview of the tasks you can perform using the PCT's graphical user interface, and then describes each of these tasks in more detail. You can also operate the PCT using its command-line interface. For information on the tool's command-line interface, refer to "Using the Performance Collection Tool's command-line interface" on page 40.

Performance Collection Tool (graphical user interface) overview



Here's an overview of the steps you'll follow when using the PCT's graphical user interface to collect either MPI and user event traces, or hardware and operating system profiles. More detailed instructions on each of the tasks summarized are provided later in this chapter. To use the PCT, you:

1. Start the PCT by using the **pct** command. For more information, refer to "Starting the Performance Collection Tool" on page 38.
2. Either load and start a new application, or connect to a running application.
   - To load and start a new application, use the Load Application Dialog to load either a serial or POE application. Using the Load Application Dialog, you can select whether you would like to merely load the application, or load the application and start its execution. If you choose to merely load the application, its execution will be suspended at its first executable instruction. This enables you to install performance collection probes before later starting application execution.
   - To connect to a running application, use the Connect Application Dialog. Using the Connect Application Dialog, you can connect to a serial or POE application. If connecting to a POE application, you can select whether you would like to connect to all processes in the POE application, or just the controlling, ″home node″, POE process. Connecting to only the controlling POE process will enable you to later connect to select tasks in the POE application, and may be desirable for performance reasons.
3. Select the type of data you will be collecting using the PCT. You can collect:
   - MPI and user event traces for analysis using the **utestats** utility or a graphical visualization tool like Jumpshot.
   - hardware and operating system profiles for analysis within the PVT.
4. If you are collecting:

MPI and user event traces

Use the Probe Selection Panel of the PCT's Main Window to specify which MPI events you want to collect data for. For example, you can select "All MPI events", "Collective communication", "Point-to-point communication", and so on. In addition to specifying MPI trace data to be collected, you can also add user markers to processes to mark events or states of interest. Marking these states or events of interest gives you a frame of reference when analyzing the trace record in a graphical visualization tool like Jumpshot. You can also use user markers to mark locations where tracing should be stopped or started. Since you can add MPI probes only at a program, file, or function level (meaning that the entire program, file, or function will be traced), this gives you more control over which part of your program is traced.

hardware and operating system profiles

Use the Probe Selection Panel of the PCT's Main Window to specify the hardware and operating system information you want to collect for later analysis within the PVT.

For POWER4 and POWER5 machines, hardware events can only be counted in predefined groupings. The POWER4 architecture supports 8 hardware counters. The POWER5 architecture supports only 6. Of the 6 counters in POWER5, counters 5 and 6 are dedicated to counting the same events (PM_INST_CMPL [Instructions Completed] and PM_RUN_CYC [Run Cycles], respectively). Thus, each POWER5 group will count 4 distinct events. For a list of supported groups, please see Appendix D, "Supported Power5 PMAPI hardware counter groupings," on page 153.

5. When you are done collecting data, you can terminate connected processes, disconnect from the processes, and/or exit the PCT.

In addition to the tasks summarized above, you can also:

- display the contents of source files in the View Source window.
- use a search string to locate functions within the Main Window's Source Tree.
- set user preferences. Specifically, you can set the:
  - search path used by the tool to locate source files for display
  - size of the buffers used when creating MPI trace files
  - maximum size of the MPI trace files
  - types of events included in MPI trace files.
- start and stop execution of connected processes. You might, for example, wish to suspend execution of your application prior to instrumenting it, and resume execution after probes have been added.
- examine standard output and error from, and send standard input to, the application using the I/O Console Window.

Starting the Performance Collection Tool

You can start the PCT in either graphical-user-interface mode or command-line mode. For instructions on starting the PCT in command-line mode, refer to "Using the Performance Collection Tool's command-line interface" on page 40. To start the PCT in graphical-user-interface mode:

1. Enter the **pct** command at the AIX command prompt.

```
$ pct
```

Doing this starts the PCT in graphical-user-interface mode and opens its first window — the Welcome Dialog.

2. The Welcome Dialog provides option buttons that enable you to select whether you would like to load a new application or connect to an existing one.

If:	Then:
You want to examine an application that is not already running.	Select the **Load a new application** option button and click the **OK** command button. Doing this closes the Welcome Dialog, and opens the Load Application Dialog. The Load Application Dialog will enable you to specify the serial or POE program you wish to run.
You want to examine an application that is already running.	Select the **Connect to a running application** option button and click the **OK** command button. Doing this closes the Welcome Dialog, and opens the Connect Application Dialog. The Connect Application Dialog will enable you to specify the serial or POE program to which you want to connect.
You do not want to make the decision between whether to load a new, or connect to an existing, application at this time.	Click on the **Cancel** command button. Doing this closes the Welcome Dialog and opens the PCT's Main Window. Since you have neither loaded a new application, nor connected to an existing application, the Main Window will not provide any application information at this time.

Accessing the Performance Collection Tool's online help system

The PCT's graphical user interface has been designed to be intuitive and easy to use. If you do have any trouble using it to accomplish the tasks outlined in "Performance Collection Tool (graphical user interface) overview" on page 37, refer to the PCT's online help system. To access the tool's online help, select **Help → Contents** off the main window's menu bar, or else press the **Help** button that appears on many of the PCT's dialogs. Doing this opens the PCT help window.

If you open the help from one of the PCT's dialogs, a help topic describing that dialog is displayed. If you open the help from the main window, a task overview topic is displayed.

The PCT help contains topics for each of the major tasks you can perform with the PCT. The left hand pane of the window enables you to navigate the help system to display the needed help topic in the right hand pane. There are three ways to navigate the help system — using the contents tab, using the index tab, or using the search tab:

- the contents tab is displayed by default. Simply click on any entry in the contents tab to display the help topic.
- the index tab shows an index of the entire help system. Simply click on any entry in the index to display its associated help topic. To search the index, type a string in the **Find** field and press **<enter>**. The first index entry containing the string is highlighted. Press **<enter>** again to search for the next occurrence of the string in the index.

- the search tab enables you to search the help for all occurrences of a text string. Simply type the string in the **Find** field and press **<enter>**. A list of all help topics containing the string is displayed. The topics are listed in descending order according to the number of occurrences of the string. The help topic with the most occurrences of the string is displayed by default.

Using the Performance Collection Tool's command-line interface

This section describes how you can use the PCT in command-line mode to collect either MPI and user event traces or hardware and operating system profiles. The purpose of this section is to illustrate how the various subcommands of the **pct** command can be used to instrument serial or POE programs. Note, however, that this section does not necessarily describe all the options of all the **pct** subcommands. For complete reference information on any of the subcommands described in this section, refer to the **pct** command's man page in Appendix A, "Parallel environment tools commands," on page 73.

This section begins with a brief overview of the tasks you can perform using the PCT's command-line interface, and then describes each of these tasks in more detail. You can also operate the PCT using its graphical user interface. For information on how to do this, refer to "Using the Performance Collection Tool's graphical user interface" on page 36.

Performance Collection Tool (command-line interface) overview

To use the PCT's command-line interface to collect either MPI and user event traces or hardware and operating system profiles:

1. Start the PCT in command-line mode by issuing the **pct** command with its **-c** option. You can optionally specify the **-s** option to instruct the PCT to read its subcommands from a script file. For more information, refer to "Starting the Performance Collection Tool in command-line mode" on page 42.
2. Either load and start a new application, or connect to a running application.
   - To load and start a new application, use the **load** subcommand to load either a serial or POE application. When you load an application, its process execution will be suspended at its first executable instruction. To start execution of one or more loaded application processes, issue the **start** subcommand. For more information, refer to "Loading and starting a new application" on page 44.
   - To connect to a running application, use the **connect** subcommand. You can connect to a serial process or a POE home node process using this subcommand. Once connected to a POE home node process, you can issue the **connect** subcommand again to connect to one or more of its individual tasks. For more information, refer to "Connecting to a running application" on page 45.

   When you load or connect to a serial or POE application, two task groups are created. A *task group* is simply a named set of tasks — in this case, the task groups are named "*all*" and "*connected*". Task groups are intended for when you are working with POE applications as opposed to serial applications. The *all* task group represents all the tasks in the POE application, while the *connected* task group represents the POE application's connected tasks only. You can also create your own named task groups. Task groups enable you to more easily manipulate the tasks of a POE application, since many of the PCT's subcommands are designed to operate upon one or more tasks. By default, the tasks operated upon are those in a "current task group" that you specify. By default, the current task group is the automatically-created task group *connected*. If you are instrumenting a serial application, you naturally do not need to concern yourself with task groups. You should be aware, however, that the *all* and *connected* groups are still created by the PCT. For more information on task groups, refer to “Grouping tasks of a POE application” on page 42.

3. Select the type of data you will be collecting using the PCT. You can collect either:
   - MPI and user event traces for analysis using the **utestats** utility or a graphical visualization tool like Jumpshot.
   - hardware and operating system profiles for analysis within the PVT.

   To specify which type of data you’ll be collecting, use the **select** subcommand. For more information, refer to “Selecting the type of probe data to be collected” on page 49.
4. Set an output location for files output by the PCT, and add probes to collect data.

<table>
<tr><th>If:</th><th>Then:</th></tr>
<tr><td>you are collecting MPI and user event traces.</td><td>1. Set the output location for the trace files that are generated by the PCT. To do this, use the trace set subcommand. For more information, refer to “Setting the output location and other preferences for the AIX trace files generated” on page 50.
2. Add MPI trace probes and/or custom user markers using the trace add subcommand. For more information, refer to “Adding MPI trace probes to processes” on page 51 and “Adding user markers to processes” on page 53.
When you are done collecting the trace data, you can remove the probes using the trace remove subcommand. For more information, refer to “Removing MPI trace probes from processes” on page 53 and “Removing user markers from processes” on page 55.</td></tr>
<tr><td>you are collecting hardware and operating system profile information.</td><td>1. Set the output location for the profile files that are generated by the PCT. To do this, use the profile set path subcommand. For more information, refer to “Setting the output location for the netCDF files generated” on page 56.
2. Add the profile probes to processes using the profile add subcommand. For more information, refer to “Adding hardware profile probes to processes” on page 56.
When you are done collecting the profile data, you can remove the probes using the profile remove subcommand. For more information, refer to “Removing hardware profile probes from processes” on page 58.</td></tr>
</table>

5. When you are done collecting data, you can terminate connected processes using the **destroy** subcommand, or disconnect from the processes using the **disconnect** subcommand. To exit the PCT, issue the **exit** subcommand. For more information, refer to “Terminating connected processes” on page 58, “Disconnecting from the application” on page 59, and “Exiting the Performance Collection Tool” on page 60.

In addition to the tasks summarized above, you can also:

- suspend and resume execution of connected processes by issuing the **suspend** and **resume** subcommands. You might, for example, wish to suspend execution of your application prior to instrumenting it, and resume execution after the probes have been added. For more information, refer to “Suspending and resuming application execution” on page 46.

- send standard input text to your application using the **stdin** subcommand. For more information, refer to "Sending standard input text to the application" on page 47.
- Display the contents of source files using the **list** subcommand. For more information, refer to "Displaying the contents of a source file" on page 47.

Starting the Performance Collection Tool in command-line mode

To start the PCT in command-line mode, enter, at the AIX command prompt, the **pct** command with its **-c** option:

```
pct -c
```

The PCT displays the `pct>` command prompt. You can now enter PCT subcommands at this prompt.

When starting the PCT in command-line mode, you can optionally specify the **-s** option to instruct the PCT to read subcommands from a particular script file of PCT subcommands. For example, to have the PCT read the subcommands in the script file *myscript.cmd*:

```
pct -c -s myscript.cmd
```

For more information on PCT script files, refer to "Creating and Running PCT script files" on page 60.

The first thing you'll want to do after starting the PCT is either connect to a running application, or load and connect to a new application. If the application you wish to examine is already running, you can connect to it; refer to "Connecting to a running application" on page 45. If the application you wish to examine is not already running, you can load it; refer to "Loading and starting a new application" on page 44. If you are going to connect or load a POE application, you need to understand the concept of task groups; refer to "Grouping tasks of a POE application."

Getting help on the PCT's command-line interface

To get a listing of all of the PCT's subcommands, enter the **help** subcommand at the `pct>` prompt.

```
pct> help
```

To get the syntax of a particular subcommand, enter the **help** subcommand followed by the name of the subcommand whose syntax you want displayed. For example, to get the syntax of the **load** subcommand.

```
pct> help load
```

Grouping tasks of a POE application

In the Parallel Operating Environment, the multiple cooperating processes of your program are referred to as "tasks". Many of the PCT subcommands are designed to operate on one or more tasks of a POE application. By default, the tasks operated upon are those in a "current task group" that you can specify. A task group is simply a named set of tasks. Two such task groups — *all* and *connected* — are created automatically when you either connect to a running application (using the **connect** subcommand), or load a new application (using the **load** subcommand). The *all* task group represents all the tasks in the POE application. The *connected* task group is the current task group by default — it represents the POE application's connected tasks only. You can also create your own task groups.

By default, the current task group will be *connected*; the subcommands you issue will act upon all connected tasks in the POE application. You can change the current task group to be the automatically created group *all*, or a task group that you have created. You can also, for all of the subcommands that act upon task groups, specify a set of tasks or a task group when issuing the subcommand. If you do this, the subcommand will operate on the tasks specified rather than the current task group. For example, consider the **suspend** subcommand for suspending execution of one or more tasks. If you issue this subcommand without options as in:

```
pct> suspend
```

The tasks in the current task group are suspended. However, if you specify a task list using the **task** clause, you suspend execution for the tasks specified — in this next example tasks 0 through 5:

```
pct> suspend task 0:5
```

Note: When using the task clause, the tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

You can also specify a named task group (other than the current task group) using the **group** clause:

```
pct> suspend group workers
```

To understand why you might want to specify a task group, consider the following example. Say that the application you're examining follows the master/workers model in which one task (the ″master″) coordinates the activities of all the other tasks — the ″workers″. You could create two task groups — one containing just the master task, and the other containing all the other tasks. To do this, you would use the **group** subcommand with its **add** clause. To create a task group *master* containing just task 0:

```
pct> group add master 0
```

To create a task group *workers* containing the tasks 1 through 10:

```
pct> group add workers 1:10
```

Once these groups are created, you can make either one the current task group. To do this, you would use the **group** subcommand with its **default** clause. For example, the following subcommand sets the current task group to be the task group *master*:

```
pct> group default master
```

While *master* is the current task group, any subcommands that operate upon tasks will operate only upon task 0 — the only task in the group *master*. To make the group *workers* the current task group:

```
pct> group default workers
```

While you cannot modify or delete the two groups that the PCT automatically creates (*all* and *connected*), you can modify and delete the groups that you have created. To add tasks 11 though 20 to the task group *workers*:

```
pct> group add workers 11:20
```

To delete task 11 from the task group *workers*:

```
pct> group delete workers 11
```

To delete the entire task group *workers*:

```
pct> group delete workers
```

Notes:

1. If you are instrumenting a serial application, you naturally do not need to concern yourself with task groups. You should be aware, however, that the *all* and *connected* groups are still created by the PCT.
2. You can list the existing task groups, or the members of a particular task group, using the **show** subcommand. For example, the following subcommand lists the existing task groups:

   ```
   pct> show groups
   Default     Group Name
   -------     ----------
               all
   @           connected
   pct>
   ```

   The @ symbol indicates which group is the current task group.

   To list the tasks in the task group *all*:

   ```
   pct> show group all
   Tid Program Name             Host             Cpu Type State
   --- ------------------------ ---------------- -------- ------
   0   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
   1   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
   2   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
   3   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
   pct>
   ```

Loading and starting a new application

If the serial or POE application you wish to examine is not already running, you can load it onto one or more nodes. When you load an application using the **load** subcommand, it is loaded in a stopped state with execution suspended at the first executable instruction. You can then start its execution using the **start** subcommand.

To load a serial application, you simply supply the **load** subcommand with the absolute path to the executable. The **exec** clause indicates the absolute path to the executable. If the application takes arguments, you can specify them using the **args** clause. For example:

```
pct> load exec /u/example/bin/foo args "a b c"
```

If loading a POE application, you specify the **poe** clause, and can also supply any POE arguments using the **poeargs** clause. For information on the POE command-line flags available to you, refer to the manual *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*.

The procedure for loading a POE application differs depending on whether the application follows the Single Program Multiple Data (SPMD) or Multiple Program Multiple Data (MPMD) model. If your program follows the SPMD model, you specify the absolute path to the executable using the **exec** clause:

```
pct> load poe exec /u/example/bin/parallel_foo poeargs \
"-procs 4 -hfile /tmp/host.list"
```

If your program follows the MPMD model, you supply the absolute path to a POE commands file (which lists the individual programs to load) using the **mpmdcmd** clause:

```
pct> load poe mpmdcmd  \
/u/example/bin/foo.cmds poeargs "-procs 3 -hfile /tmp/host.list"
```

For information on creating a POE commands file for loading multiple programs, refer to the manual *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*.

The **load** subcommand also enables you to specify that standard input, standard output, or standard error should be redirected. To read standard input from a file, use the **stdin** clause:

```
pct> load exec /u/example/bin/foo args "a b c" stdin input_file
```

To redirect standard output to a file, use the **stdout** clause:

```
pct> load exec /u/example/bin/foo args "a b c" stdout output_file
```

To redirect standard error to a file, use the **stderr** clause:

```
pct> load exec /u/example/bin/foo args "a b c" stderr error_file
```

When you load an application, two task groups — *all* and *connected* — are automatically created, and *connected* is made the current task group. Task groups are important to know about only if you are working with a POE application and are described in "Grouping tasks of a POE application" on page 42. Also note that the application is loaded in a stopped state with execution suspended at the first executable instruction. To start execution of the application, use the **start** subcommand:

```
pct> start
```

Connecting to a running application

If the serial or POE application you wish to examine is already running, you can connect to it using the **connect** subcommand. To list the processes to which you can connect, use the **show** subcommand with its **ps** clause:

```
pct> show ps
Pid   Command
----- ---------------------------------------------------------------
10652 /home/strofino/dpcltest/WORK/prod_cons
13256 /etc/dpcld /tmp/dpclsd
13316 /home/strofino/dpcltest/WORK/prod_cons
14302 /usr/lpp/ppe.dpcl/dpcl_beta/bin/poe
18108 /home/strofino/dpcltest/WORK/prod_cons
20614 /u/alfeng/public/perf/seqsleep
21996 /u/alfeng/bin/sesmgr
22644 /home/strofino/dpcltest/WORK/prod_cons
22802 java com/ibm/ppe/perf/main/Startup -l /u/alfeng/bin/sesmgr -cmd
23236 -ksh
24894 /etc/dpcld /tmp/dpclsd
27632 -ksh
pct>
```

If you are connecting to a serial application, you simply supply the process ID of the process you wish to connect to using the **pid** clause of the **connect** subcommand.

```
pct> connect pid 12345
```

If you are connecting to a POE application, you connect to the processes in two steps. First, you issue the **connect** subcommand to connect to the controlling, home node, POE process. Once connected to the controlling POE process, you can then reissue the **connect** subcommand to connect to any of its processes. For example, to connect to the application whose AIX process ID is 12345:

```
pct> connect poe pid 12345
```

When you connect to the POE home node process, the PCT creates two task groups — *all* and *connected*. The *all* task group refers to all of the tasks in the application, while the *connected* task group refers only to connected tasks. The *connected* task group will initially be empty since no tasks are connected. You can list the existing task groups by issuing the **show** subcommand with its **groups** clause:

```
pct> show groups
Default     Group Name
-------     ----------
            all
@           connected
pct>
```

To connect to all tasks in the POE application:

```
pct> connect group all
```

To connect to select tasks in the POE application, use the **task** clause:

```
pct> connect task 2,3
```

Suspending and resuming application execution

The PCT enables you to suspend and resume execution of connected processes by issuing the **suspend** and **resume** subcommands. You might, for example, wish to suspend execution of your target application prior to instrumenting it as described in "Collecting MPI trace and custom user marker information" on page 49. Once your performance collection probes have been added to the application, you could resume the application's execution. By default, the **suspend** and **resume** subcommands act upon the current task group. Unless you have specified another task group to be the current task group, the current task group will be the task group *connected*. The task group *connected* is created automatically by the PCT when you either connect to or load an application (as described in "Connecting to a running application" on page 45 and "Loading and starting a new application" on page 44). The task group *connected* consists of all connected tasks in a POE application. If you are instrumenting a serial application, you do not need to concern yourself with task groups. If you are instrumenting a POE application, however, it is useful to understand the concept of task groups as described in "Grouping tasks of a POE application" on page 42.

To suspend execution of the tasks in the current task group:

```
pct> suspend
```

To suspend execution of tasks in a specific task group (in this case, the task group *connected*), use the **group** clause on the **suspend** subcommand:

```
pct> suspend group connected
```

To suspend a specific set of tasks in a POE application, use the **task** clause on the **suspend** subcommand. To determine how many tasks are available, you can use the **show group** subcommand to list the tasks in the task group *all*:

```
pct> show group all
Tid Program Name            Host             Cpu Type State
--- ----------------------- ---------------- -------- ------
0   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
```

```
1   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
2   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
3   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
pct> suspend task 1,3
```

The **resume** subcommand works in the same way. By default, it operates on the current task group:

```
pct> resume
```

But you can override this by specifying a task group:

```
pct> resume group connected
```

or supplying a task list:

```
pct> resume task 1,5
```

Sending standard input text to the application

If you have loaded an application (as described in "Loading and starting a new application" on page 44), you can use the **stdin** subcommand to send standard input text to your application. However, if you have instead merely connected to an application (as described in "Connecting to a running application" on page 45), you cannot send standard input text to the application using the **stdin** subcommand.

If you are instrumenting a serial application, the standard input text will be sent to that application process. If you are instrumenting a POE application, the standard input text will be sent to the controlling, "home node", POE process. As described in "Loading and starting a new application" on page 44, you can, when loading an application using the **load** subcommand, specify that standard input should be read from a file. If you are reading standard input from a file, you cannot use the **stdin** subcommand.

To send a standard input string to the application, specify the string on the **stdin** subcommand. The string must be enclosed in double quotes:

```
> stdin "Now is the time for all good men"
```

If desired, you can use embedded formatting characters (such as **\n**) in your standard input string:

```
> stdin "Now is the time \nfor all good men"
```

To send a newline character to the input stream reading this input data, issue the **stdin** command without any text string:

```
stdin
```

To send an end-of-file character to the input stream reading this input data, use the **eof** clause on the **stdin** subcommand:

```
> stdin eof
```

Displaying the contents of a source file

Using the **list** subcommand, you can display the contents of source files. Unless you are certain of the file name of the source file you want to examine, you may want to list the available source files using the **file** subcommand. The **file** subcommand lists, for one or more connected tasks, the associated source file names that match a regular expression you supply. By default, the **file** subcommand acts upon the current task group. Unless you have specified another task group to be the current task group (as described in "Grouping tasks of a POE application" on page 42), the current task group will be the task group *connected*.

The task group *connected* is created automatically by the PCT when you either connect to or load an application (as described in “Connecting to a running application” on page 45 and “Loading and starting a new application” on page 44). The task group *connected* consists of all connected tasks in a POE application. If you are instrumenting a serial application, you do not need to concern yourself with task groups. If you are instrumenting a POE application, however, it is useful to understand the concept of task groups as described in “Grouping tasks of a POE application” on page 42.

You supply the **file** subcommand with an AIX regular expression file-matching pattern (enclosed in double quotation marks) to match the source files you want to list. For example, to list all the available source files in the current task group:

```
pct> file "*"
Tid     File Id     File Name    Path
---     -------     ---------    -------------
0       0           bar.c        ../../lib/src
0       1           foo1.c       ../../lib/src
0       2           foo2.c       ../src
pct>
```

Although this subcommand, by default, acts upon the current task group, you can specify that it should instead act upon a different task group, or all the tasks in a task list that you supply. This is done by using the **task** or **group** clause on the **file** subcommand. For more information on the **task** and **group** clauses, refer to “Grouping tasks of a POE application” on page 42.

After issuing the **file** subcommand, you’ll have both the file name and the file identifier of the source file(s) you want to examine. Now you can use the **list** subcommand to display the contents of one or more files. Like the **file** subcommand, the **list** subcommand will, by default, act upon the current task group. Using either the **file** or **fileid** clause of the **list** subcommand, you indicate the file(s) whose contents you want listed.

When listing the contents of files using the **list** subcommand, the PCT uses a special source path to locate the source files. This source path is, by default, the directory in which the PCT was started, and can be displayed using the **sourcepath** clause on the **show** subcommand as in:

```
pct> show sourcepath
Path
----
./
pct>
```

To modify the source path so that the PCT can locate source files that are not located in the directory in which the tool was started, use the **set** subcommand. As with setting your AIX **PATH** environment variable, you separate the various directories in your source path using colons. For example:

```
pct> set sourcepath "/afs/aix/u/jbrady:/afs/aix/u/dlecker"
```

Using the **file** clause, you supply the **list** subcommand with an AIX regular expression file-matching pattern (enclosed in double quotation marks) to match the source file(s) whose contents you want to list. If desired, you can supply additional regular expressions separated by commas (`file "f*","b*"`). For example, the following subcommand lists the contents of the file *bar.c*:

```
pct> list file "bar.c"
```

While this subcommand lists the contents of the first file found in the application that begins with the letter "f":

```
pct> list file "f*"
```

Using the **fileid** clause, you identify the file whose contents you want to list using the process identifier(s) returned by the **file** subcommand. For example, the following subcommand lists the contents of the file *bar.c* (whose file identifier is 0):

```
pct> list fileid 0
```

You can also use the **line** clause of the **list** subcommand to list only a portion of the file's contents. Use a colon to separate the ends of the line number range. For example, the following subcommand lists lines 1 through 20 of the file *bar.c*.

```
pct> list file "bar.c" line 1:20
```

To list the next few lines in *bar.c*, simply specify the **next** clause on the **list** subcommand.

```
pct> list next
```

Selecting the type of probe data to be collected

The PCT is capable of collecting two different types of information. It can collect:

- MPI and user event traces for analysis using the **utestats** utility or a graphical visualization tool like Jumpshot (a public domain tool developed at Argonne National Lab). For more information on the **utestats** utility, as well as utilities for converting the AIX trace files created by the PCT into a format readable by **utestats** and Jumpshot, refer to "Creating, converting, and viewing information contained in UTE interval files" on page 61.
- Hardware and operating system profiles for analysis within the PVT. For more information on the PVT, refer to "Using the Profile Visualization Tool" on page 65.

Be aware that, before you can collect either type of information, you must specify, using the **select** subcommand, which type you are interested in:

If you want to collect:	Then:
MPI and user event traces.	Specify the **trace** clause on the **select** subcommand: `select trace`
Hardware and operating system profiles.	Specify the **profile** clause on the **select** subcommand: `select profile`

Note: You can select the type of data to collect only once per load and connect.

Collecting MPI trace and custom user marker information

Using the PCT, you can collect MPI and user event traces for:

- analysis using the **utestats** utility
- eventual analysis within a graphical visualization tool like Jumpshot

The trace information collected is stored as an AIX trace file on each node running instrumented processes. After you have generated these AIX trace files, you can convert them into the Unified Trace Environment (UTE) format (using the **uteconvert** utility) for analysis using the **utestats** utility. You can then also convert the UTE files into the SLOG2 format (using the **traceTOslog2** utility) for analysis within Jumpshot. For more information on the utilities for converting the AIX trace files output by the PCT into formats readable by the **utestats** utility and Jumpshot, refer to “Creating, converting, and viewing information contained in UTE interval files” on page 61.

In order to collect MPI trace information, the application to be traced must be linked with the *libute_r.a* library. To cause this UTE library to be added to the link step, set the **MP_UTE** environment variable to *yes*.

Before you can use any of the MPI trace collection subcommands described in this section, you must first specify that you are collecting MPI trace information rather than hardware profile information. Refer to “Selecting the type of probe data to be collected” on page 49 for more information. Once you have indicated that you’ll be collecting MPI and/or user event traces, you can select the output location for the trace files generated by the PCT. To do this, you simply supply an output directory and ″base name″ (file prefix) for the trace files. Refer to “Setting the output location and other preferences for the AIX trace files generated” for more information. You can collect information about:

- standard MPI messaging events such as collective communication, point-to-point communication, or one-sided communication. This is done by adding MPI data collecting probes to one or more application task. Refer to “Adding MPI trace probes to processes” on page 51 for more information.
- events of interest (such as program function calls). This is done by installing a simple user marker into one or more application task at an instrumentation point in the code. Instrumentation points are locations in the code (such as function call sites) where it is safe to install probes. A simple marker will appear in the trace record as a single point; its position gives you a frame of reference when analyzing a trace record in a graphical visualization tool like Jumpshot.
- states of interest. This is done by installing beginning and ending state user markers in the code at particular instrumentation points. A state will appear in the trace record as a region and, like the simple markers, gives you a frame of reference when analyzing a trace record in a graphical visualization tool like Jumpshot.

Setting the output location and other preferences for the AIX trace files generated: The trace information collected by the PCT is stored as a separate AIX trace file on each node running instrumented processes. You can select the output location and other preferences for the trace files using the **trace set** subcommand.

To specify:	Use this clause of the trace set subcommand:	For example:
The output location and a ″base name″ prefix for the generated files.	**path**	`pct> trace set path "/home/timf/trace files/mytrace"` Specifies */home/timf/tracefiles* as the location for the generated files. The basename prefix is *mytrace*.
The AIX trace buffer size in Kilobytes. This value can be at most 1024, which is the default.	**bufsize**	`pct> trace set bufsize 1000`

To specify:	Use this clause of the trace set subcommand:	For example:

The type of events (MPI events, process dispatch events, and CPU idle events) that are traced. By default, MPI and process dispatch events are traced. Tracing process dispatch events and CPU idle events can result in larger trace files, but the additional information can provide useful context for the MPI information collected.	**event**	`pct> trace set event mpi`
		`pct> trace set event process`
		`pct> trace set event idle`

The maximum trace file size in Megabytes. This can be any value between 2 and 2048 inclusive. The default is 20.	**logsize**	`pct> trace set logsize 25`

Adding MPI trace probes to processes: By adding MPI trace probes to processes, you can trace such MPI events as collective communication, point-to-point communication, and one-sided communication.

To add MPI trace probes, you'll need to know the specific MPI probe type identifier or name as returned by the **trace show** subcommand. To list the available MPI probe type identifiers and names, specify the **probetypes** clause on the **trace show** subcommand:

```
pct> trace show probetypes
MPI Id MPI Name    Description
------ ----------- -------------------------------------
0      all         all MPI events
1      blkcollcomm blocking collective communication
2      pttopt      point-to-point communication
3      onesided    one-sided communication
4      commgroup   communication groups
5      topo        topologies
6      collcomm    non-blocking collective communications
7      env         environmental
8      data        data type
9      file        file
10     info        information
11     comm        communicators
12     wait        wait calls
13     test        test calls
pct>
```

Once you have the probe type information, you can use the **trace add** subcommand to add one or more probe types to one or more processes. You can add the probes at the file level, in which case the MPI events for the entire file will be traced, or at the function level. If that granularity is not small enough, and you want to trace only a portion of a function, you can use special markers to force tracing on and off at particular points.

By default, the **trace add** subcommand acts upon the current task group. Unless you have specified another task group to be the current task group (as described in "Grouping tasks of a POE application" on page 42), the current task group will be the task group *connected*. The task group *connected* is created automatically by the PCT when you either connect to or load an application (as described in "Connecting to a running application" on page 45 and "Loading and starting a new application" on page 44). The task group *connected* consists of all connected tasks in a POE application. If you are instrumenting a serial application, you do not need to concern yourself with task groups. If you are instrumenting a POE application, however, it is useful to understand the concept of task groups as described in "Grouping tasks of a POE application" on page 42.

Note: The set of tasks in which you will add the probes cannot include different executables in an MPMD application. For example, if an MPMD application consists of executables *a.out* and *b.out*, then this command cannot be applied to a task group that contains both *a.out* and *b.out* tasks.

If you are tracing at the file level, you'll need to specify the files using either the **file** or **fileid** clause on the **trace add** subcommand. To do this, you'll need the file identifier or file name information as returned by the **file** subcommand. To list all available source files in the current task group:

```
pct> file "*"
Tid File Id File Name Path
--- ------- --------- -------------
0   0       bar.c     ../../lib/src
0   1       foo1.c    ../../lib/src
0   2       foo2.c    ../src
pct>
```

To add a certain type of MPI probe, you supply the **trace add** subcommand with the MPI probe type and file information. You can specify the MPI probe type by supplying the:

- MPI probe type identifier using the **mpiid** clause
- MPI probe type name using the **mpiname** clause

Similarly, you can specify the file information by supplying the:

- file identifier using the **fileid** clause
- file name using the **file** clause and a regular expression

For example:

```
pct> trace add mpiid 0 to fileid 0

pct> trace add mpiname all to file "bar.c"
```

You can also specify multiple MPI probe types or multiple files:

```
pct> trace add mpiid 1,2 to fileid 0,1

pct> trace add mpiname collcom,pttopt to file "bar.c","f*"
```

If you would like to trace at a function level rather than tracing an entire file, you need to specify the function(s) using either the **function** or **funcid** clause. You'll need the function identifier or function name information as returned by the **function** subcommand. To list all functions in the file *bar.c*:

```
pct> function file "bar.c" "*"
Tid File Id Function Id File Name Function Name
--- ------- ----------- --------- -------------
0   1       0           bar.c     func0
0   1       1           bar.c     func1
pct>
```

Note:

If you wish to instrument a particular function, but do not know which file the function is located in, you can use the **find** subcommand. For example, to search all files in task 0 for functions that match the regular expression *comp**:

```
pct> find task 0 function "comp*"
Tid File Id File Name Function Name
--- ------- --------- -------------
0   23      main.c    compute
0   23      main.c    compare
0   25      sort.c    compare2
pct>
```

You can then specify the function on the **trace add** subcommand:

```
pct> trace add mpiid 0 to file "bar.c" function "func0"
```

You can also specify multiple functions:

```
pct> trace add mpiid 0 to file "bar.c" function "*"

pct> trace add mpiid 0 to file "bar.c" function "func0","func1"
```

Removing MPI trace probes from processes: When you issue the **trace add** subcommand to install MPI trace probes, the probes are given a unique probe identifier. You can use the probe identifier on the **trace remove** subcommand to remove the probes. To ascertain the probe identifier, use the **trace show** subcommand with its **probes** clause as in:

```
pct> trace show probes
Probe Id Command
-------- ---------------------------------------------------------------
0        trace add mpiid 0 to file "prod_cons.c" function "alarm_handler"
1        trace add mpiid 0 to file "prod_cons.c" function "consume"
pct>
```

To remove the probe set whose probe identifier is 0:

```
pct> trace remove probe 0
```

Adding user markers to processes: *User markers* are special types of probes that you can install at specific instrumentation points in your application code. You can:

- Mark events of interest (such as program function calls) using a *simple marker*. A simple marker will appear in the trace record as a single point; its position gives you a frame of reference when analyzing the trace record in a graphical visualization tool like Jumpshot.
- Mark a state of interest using a *begin state marker* and an *end state marker*. A state marked by begin and end state markers will appear in the trace record as a region. Like the simple markers, this gives you a frame of reference when analyzing the trace record in a graphical visualization tool like Jumpshot.
- Force tracing on or off using a *trace on marker* or a *trace off marker*.

To install a user marker, you'll need to identify not only the file and function, but also the instrumentation point at which you want the probe installed. To list instrumentation points, issue the **point** subcommand.

```
pct> point task 0 file "bar.c"
Tid File Id Function Id Point Id Point Type Callee Name
--- ------- ----------- -------- ---------- ------------
0   54      0           0        0
0   54      0           1        2          printf
0   54      0           2        3          printf
0   54      0           3        2          MPI_Abort
0   54      0           4        3          MPI_Abort
0   54      0           5        1
0   54      1           0        0
0   54      1           1        2          printf
0   54      1           2        3          printf
0   54      1           3        2          printf
0   54      1           4        3          printf
0   54      1           5        2          MPI_Recv
0   54      1           6        3          MPI_Recv
0   54      1           7        2          consume_data
0   54      1           8        3          consume_data
0   54      1           9        2          printf
0   54      1           10       3          printf
0   54      1           11       1
pct>
```

To understand the point type number returned by the **point** command, issue the **show points** command.

```
pct> show points
Point Type  Point Name
----------  ----------
0           function entry
1           function exit
2           before callsite
3           after callsite
pct>
```

To:	Use:	For example:
mark a state of interest.	the **simplemarker** clause on the **trace add** subcommand.	`pct> trace add simplemarker "simple" to file "bar.c" funcid 0 pointid 0`

To:	Use:	For example:

mark a region	the **beginmarker** and **endmarker** clauses on the **trace add** subcommand. You must mark the beginning and end of the range with the same ″marker name″ (a string that will be used to identify the user state in the trace record). You can only use a particular name for one begin marker/end marker pair. The state will appear in the trace record as a region.
	
	You should place all markers after the target application's call to *MPI_init* (which initializes MPI), and before the call to *MPI_Finalize* (which terminates MPI processing). For more information in the *MPI_init* and *MPI_Finalize* calls, refer to the *IBM Parallel Environment for AIX: MPI Programming Guide* or the *IBM Parallel Environment for AIX: MPI Subroutine Reference*.
	
	When marking a region, you must ensure that the begin and end state markers are placed so that if either marker is reached during execution, the other marker will also be reached. If you nest region markers, you must also ensure that the regions are properly nested. In other words, the inner region should be fully enclosed by the outer region. If you do not follow these guidelines, and the begin and end state markers are not correctly nested, you will get an error when you run the **uteconvert** utility. For more information on the **uteconvert** utility, refer to "Creating, converting, and viewing information contained in UTE interval files" on page 61.
		`pct> trace add beginmarker "green" to file "bar.c" funcid 1 pointid 0`
		
		`pct> trace add endmarker "green" to file "bar.c" funcid 1 pointid 1`

force tracing on or off	the **traceon** or **traceoff** clause on the **trace add** subcommand.	`pct> trace add traceoff to file "bar.c" funcid 0 pointid 0`
		
		`pct> trace add traceon to file "bar.c" funcid 0 pointid 1`

Removing user markers from processes: When you issue the **trace add** subcommand to install a custom user marker, the marker is given a unique marker identifier. You can use this marker identifier on the **trace remove** subcommand to remove the markers. To ascertain the marker identifier, use the **trace show** subcommand with its **markers** clause as in:

```
pct> trace show markers
Marker Id Command
--------- -------
0         trace add simplemarker "simple" to file "bar.c" funcid 0 pointid 0
1         trace add beginmarker "green" to file "bar.c" funcid 1 pointid 0
2         trace add endmarker "green" to file "bar.c" funcid 1 pointid 1
pct>
```

To remove the marker whose identifier is 2:

```
> trace remove marker 2
```

Collecting hardware and operating system profile information

Using the PCT, you can collect hardware and operating system profiles for analysis within the PVT.

The profile information collected is stored in netCDF (network Common Data Form) format on each node running instrumented processes. The PVT can read netCDF files and summarize the profile information in reports. For more information on using the PVT to read netCDF files output by the PCT, refer to "Using the Profile Visualization Tool" on page 65.

Before you can use any of the profile collection subcommands described in this section, you must first specify that you are collecting hardware profile information rather than MPI and user event traces. Refer to "Selecting the type of probe data to be collected" on page 49 for more information. Once you have indicated that you'll be collecting hardware profile information, you can select the output location for the netCDF files generated by the PCT. To do this, you simply supply an output directory and "base name" (file prefix) for the netCDF files. Refer to "Setting the output location for the netCDF files generated" for more information.

Setting the output location for the netCDF files generated: The hardware profile information is saved as a separate netCDF file on each node running instrumented processes. Using the **profile set path** subcommand, you can specify the output location and "base name" file prefix for these files. For example:

```
pct> profile set path "profile/output"
```

Adding hardware profile probes to processes: By adding hardware profile probes to processes, you can collect hardware and operating system information such as elapsed wall-clock time, process resource usage, and hardware counters. To add hardware profile probes, you need to know the specific probe type identifier or name as returned by the **profile show** subcommand. To list available probe type identifiers and names, specify the **probetypes** clause on the **profile show** subcommand.

For example:

```
pct> profile show probetypes
Prof Id Prof Name Description
------- --------- ----------------
0       wclock    wall clock
1       rusage    resource usage
2       hwcount   hardware counter
pct>
```

For hardware counters, you can also display a list of the specific hardware counter information you can collect. The list of available hardware counter groups will differ depending on whether the current or supplied task group:

- has tasks running only on 604e CPUs
- has tasks running only on 630 CPUs

If the current or supplied task group has tasks running on mixed CPUs, then no hardware counters are available, and so none will be listed.

To list available hardware counter groups, specify the **probetype hwcount** clauses on the **profile show** subcommand:

```
pct> profile show probetype hwcount
Prof Type Name    Description
--------- ------- ---------------------------------
0         FPU     FPU, FXU, and LSU operations
1         Branch  Branch operations
2         L1_TLB  L1 cache and TLB operations
3         L2      Prefetch and L2 cache operations
4         Fpop    Floating-point operations
5         xFPU    FPU, FXU, LSU, and BPU operations
pct>
```

The hardware counter groups you see listed are, by default, the hardware counter groups we have created.

Once you have the probe type and hardware counter information, you can use the **profile add** subcommand to add one or more probe types to one or more processes. You can add the probes at the file level, in which case profile information for the entire file will be produced, or at the function level.

By default, the **profile add** subcommand acts upon the current task group. Unless you have specified another task group to be the current task group (as described in "Grouping tasks of a POE application" on page 42), the current task group will be the task group *connected*. The task group *connected* is created automatically by the PCT when you either connect to or load an application (as described in "Connecting to a running application" on page 45 and "Loading and starting a new application" on page 44). The task group *connected* consists of all connected tasks in a POE application. If you are instrumenting a serial application, you do not need to concern yourself with task groups. If you are instrumenting a POE application, however, it is useful to understand the concept of task groups as described in "Grouping tasks of a POE application" on page 42.

Note: The set of tasks in which you will add the probes cannot include different executables in an MPMD application. For example, if an MPMD application consists of executables *a.out* and *b.out*, then this command cannot be applied to a task group that contains both *a.out* and *b.out* tasks.

If you are collecting profile information at the file level, you'll need to specify the files using either the **file** or **fileid** clause on the **profile add** subcommand. To do this, you'll need the file identifier or file name information as returned by the **file** subcommand. To list all available source files in the current task group:

```
pct> file "*"
Tid File Id File Name Path
--- ------- --------- -------------
0   0       bar.c     ../../lib/src
0   1       foo1.c    ../../lib/src
0   2       foo2.c    ../src
pct>
```

To add a certain type of profile probe, you can supply the **profile add** subcommand with the profile probe type and option information, as well as the file information. You can specify:

- the profile probe type by supplying the:
  - profile probe type identifier using the **profid** clause
  - profile probe type name using the **profname** clause
- the hardware profile group using the **groupid** or **groupname** clause
- the file information by suppling the:
  - file identifier using the **fileid** clause
  - file name using the **file** clause and a regular expression

For example:

```
pct> profile add profname wclock to fileid 0

pct> profile add profid 0 to file "bar.c"

pct> profile add profname hwcount groupid 2 to fileid 3
```

You can also specify multiple profile probe types or multiple files:

```
pct> profile add profname wclock profname hwcount groupid 2 to fileid 3,4
```

If you would like to collect profile information at the function level (instead of collecting profile information for an entire file), you'll need to specify the function(s) using either the **function** or **funcid** clause. You'll need the function identifier or function name information as returned by the **function** subcommand. To list all the functions in the file *bar.c*:

```
pct> function file "bar.c" "*"
Tid File Id Function Id File Name Function Name
--- ------- ----------- --------- -------------
0   1       0           bar.c     func0
0   1       1           bar.c     func1
pct>
```

You can specify the function on the **profile add** subcommand using its identifier or name:

```
pct> profile add profname wclock to file "bar.c" function "func0"

pct> profile add profname wclock to file "bar.c" funcid 0
```

You can also specify multiple functions:

```
pct> profile add profname wclock to file "bar.c" funcid 0,1

pct> profile add profname wclock to file "bar.c" function "*"

pct> profile add profname wclock to file "bar.c" function "func0","func1"
```

Removing hardware profile probes from processes: When you issue the **profile add** subcommand to install profile probes, the probes are given a unique probe identifier. You can use this probe identifier on the **profile remove** subcommand to remove the probes. To ascertain the probe identifier, use the **profile show** subcommand with its **probes** clause as in:

```
pct> profile show probes
Probe Id Command
-------- -------------------------------------------------------------------
0        profile add profid 0 to file "prod_cons.c" function "alarm_handler"
1        profile add profid 0 to file "prod_cons.c" function "consume"
pct>
```

To remove the probe set whose identifier is 0:

```
pct> profile remove probe 0
```

Terminating connected processes

The PCT enables you to terminate execution of connected processes by issuing the **destroy** subcommand. You might, for example, wish to terminate execution of your target application after you have finished examining it. By default, the **destroy** subcommand acts upon the current task group. Unless you have specified another task group to be the current task group (as described in "Grouping tasks of a POE application" on page 42), the current task group will be the task group *connected*. The task group *connected* is created automatically by the PCT when you either connect to or load an application (as described in "Connecting to a running application" on page 45 and "Loading and starting a new application" on page 44). The task group *connected* consists of all connected tasks in a POE application. If you are instrumenting a serial application, you do not need to concern yourself with task groups. If you are instrumenting a POE application, however, it is useful to understand the concept of task groups as described in "Grouping tasks of a POE application" on page 42.

Note: When working with a POE application, be aware that terminating any process of the application will cause POE to terminate **all** of the application's processes. This termination of all processes is a function of POE, not of the PCT. For more information, refer to the manual *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*.

To terminate execution of all tasks in the current task group:

```
pct> destroy
```

To terminate execution of tasks in a specific task group (in this case, the task group *connected*), use the **group** clause on the **destroy** subcommand.

```
pct> destroy group connected
```

To terminate a specific set of tasks in a POE application, use the **task** clause on the **destroy** subcommand. To determine how many tasks are available, you can use the **show group** subcommand to list the tasks in the task group *all*:

```
pct> show group all
Tid Program Name            Host             Cpu Type State
--- ----------------------- ---------------- -------- ------
0   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
1   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
2   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
3   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
.
.
.
pct> destroy task 1,3
```

You can also, optionally, terminate execution of all connected tasks when exiting the PCT. To do this, use the **exit** command with its **destroy** clause (as described in "Exiting the Performance Collection Tool" on page 60).

Disconnecting from the application

Once you are through examining a particular application, or particular tasks in an application, you can disconnect from the application or application tasks by issuing the **disconnect** subcommand. Once a process is disconnected, the PCT will no longer be able to control execution of, or instrument, the process unless it reconnects to the process. By default, the **disconnect** subcommand acts upon the current task group. Unless you have specified another task group to be the current task group (as described in "Grouping tasks of a POE application" on page 42), the current task group will be the task group *connected*. The task group *connected* is created automatically by the PCT when you either connect to or load an application (as described in "Connecting to a running application" on page 45 and "Loading and starting a new application" on page 44). The task group *connected* consists of all connected tasks in a POE application. If you are instrumenting a serial application, you do not need to concern yourself with task groups. If you are instrumenting a POE application, however, it is useful to understand the concept of task groups as described in "Grouping tasks of a POE application" on page 42.

To disconnect all tasks in the current task group:

```
pct> disconnect
```

To disconnect tasks in a specific task group (in this case, the task group *connected*), use the **group** clause on the **disconnect** subcommand.

```
pct> disconnect group connected
```

To disconnect a specific set of tasks in a POE application, use the **task** clause on the **disconnect** subcommand. To determine how many tasks are available, you can use the **show group** subcommand to list the tasks in the task group *all*:

```
pct> show group all
Tid Program Name            Host             Cpu Type State
--- ----------------------- ---------------- -------- ------
0   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
1   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
2   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded
3   /home/strofino/prod_cons pe04.pok.ibm.com Unknown  Loaded.
.
.
pct> disconnect task 1,3
```

Exiting the Performance Collection Tool

To exit the PCT and return to your AIX command prompt, issue the **exit** subcommand:

```
pct> exit
```

If you loaded the target application, it will be terminated when PCT exits. If you merely connected to the target application, you must explicitly instruct the PCT to terminate processes. To terminate execution of all connected processes as you exit the PCT, include the **destroy** clause on the **exit** subcommand.

```
pct> exit destroy
```

Creating and Running PCT script files

Using the command-line interface of the PCT, you are able to run a series of commands that are stored in a file. This file, called a ″PCT script file″ is a simple text file that lists a sequence of PCT commands that you want to run. Because PCT script files are reusable, they are ideal for situations where you have a set of commands you want to run during multiple PCT sessions. For example, you might want to create a PCT script file that loads and prepares an application so that you can then perform a variety of tasks on the prepared application.

To create a PCT script file, use any ASCII text editor. In the file, place one PCT command per line. You can add comment lines to the file using the # (pound sign) character. For example, here is a simple PCT script file.

```
# This example uses the 'chaotic' application from the DPCL samples.
# The script loads a four-way chaotic application, inserts probes,
# starts the application, and then waits for the application to complete
load poe exec /home/user/chaotic poeargs "-procs 4"
select trace
trace set path "/scratch/trace_out"
trace add mpiid 0 to file "chaotic.f"
start
wait
```

In the sample PCT script file shown above, note the use of the **wait** subcommand. You need to use the **wait** subcommand in PCT script files to prevent the PCT from exiting before it has collected probe data. The **wait** subcommand blocks the PCT's execution so that it can wait for asynchronous events (such as a task terminating) to occur. When one of these asynchronous events occurs, the PCT resumes execution and returns the event that occurred. Be aware that the **wait** subcommand is intended for use only within PCT script files; it is not intended for interactive command-line sessions.

To run the script file, you can either use the **-s** option of the **pct** command when starting the tool (as described in "Starting the Performance Collection Tool in command-line mode" on page 42), or you can use the **run** subcommand of the **pct** command. For example, to run the PCT script file *myscript.cmd* when starting the tool, you would enter the following at the AIX command prompt:

```
pct -c -s myscript.cmd
```

Alternatively, you could run the *myscript.cmd* script file using the **run** subcommand. For example:

```
pct> run "myscript.cmd"
```

Creating, converting, and viewing information contained in UTE interval files

When you collect MPI and user event traces using the PCT (as described in "Using the Performance Collection Tool" on page 36), the collected information is saved, on each machine running instrumented processes, as a standard AIX event trace file. In order to view the information contained in these standard AIX trace files, you will first need to convert them into UTE (Unified Trace Environment) interval files. While an AIX event trace file has a time stamp indicating the point in time when an event occurred, UTE interval files take this information to also determine how long an event lasts. Because they include this duration information, UTE interval files are easier to visualize than traditional AIX event trace files. The UTE utilities are:

- The **uteconvert** utility which coverts AIX event trace files into UTE interval trace files.
- The **utemerge** utility which merges multiple UTE interval files into a single UTE interval file.
- The **utestats** utility which generates statistics tables from UTE interval files.
- The libTraceInput.so library which is used with Argonne National Laboratory's traceTOslog2 utility to convert UTE interval files into the slog2 format viewable by Argonne National Laboratory's Jumpshot tool. The traceTOslog2 utility can be obtained using the URL http://www-unix.mcs.anl.gov/perfvis/download/index.htm#slog2sdk. The latest version of jumpshot can be obtained using the URL http://www-unix.mcs.anl.gov/perfvis/software/viewers/index.htm#Jumpshot-4.

Figure 2 on page 35 illustrates the UTE utilities you can use to either generate statistics tables from UTE interval files or view statistics graphically using Argonne National Laboratory's Jumpshot tool. Regardless of whether you want to view the statistics in simple tables or graphically in Jumpshot, the first thing you'll need to do is use the **uteconvert** utility to create UTE interval files from the AIX trace files (**a**). (See "Converting AIX trace files into UTE interval trace files" on page 62 for more information.) Then, if you want to view the statistics in simple tables (**b**), you can use the **utestats** utility. You can optionally merge multiple UTE files into a single UTE file using the **utemerge** utility before using the **utestats** utility to generate the statistics tables. (See "Generating statistics tables from UTE interval trace files" on page 63 for more information.) If you instead want to view the information contained in the UTE interval files graphically (**c**), you can convert them into SLOG2 files using the **traceTOslog2** utility. The SLOG2 files are readable by Argonne National Laboratory's Jumpshot Tool. (See "Converting UTE interval files into SLOG2 files required by Argonne National Laboratory's Jumpshot Tool" on page 64 for more information.)

Note: The UTE utilities are intended only for the AIX event trace files generated when you collect MPI and user event traces with the PCT. If you instead collect hardware and operating system profiles, the information is output by the PCT as netCDF (network Common Data Form) files and these UTE utilities are not necessary. Instead, the netCDF files can be read directly into the PVT as described in "Using the Profile Visualization Tool" on page 65.

The following sections provide an overview of the UTE utilities. Note, however, that this section does not attempt to describe all the options available when using these utilities. For complete reference information on any of the utilities described in this section, refer to their man pages contained in Appendix A, "Parallel environment tools commands," on page 73.

Converting AIX trace files into UTE interval trace files

Regardless of whether you want to view the statistics you have collected in simple tables, or graphically in Jumpshot, the first thing you'll need to do is use the **uteconvert** utility to create UTE interval files from the AIX trace files generated by the PCT. When you collect MPI and user event traces, the collected information is saved, on each machine running instrumented processes, as a standard AIX event trace file. The names of these individual trace files will consist of a common ″base name″ that you specified using the PCT, followed by a node-specific suffix supplied by the tool itself. Using the **uteconvert** utility, you can convert either a single AIX trace file into a UTE interval file, or a set of AIX trace files with the same prefix into a set of UTE interval files.

To convert a single AIX trace file into a UTE interval file, simply pass the **uteconvert** utility the name of the trace file located in the current directory. For example, to convert the AIX trace file *mytrace* into a UTE interval trace file, enter:

```
uteconvert mytrace
```

Using the **-o** flag, you can optionally specify the name of the output UTE interval file. For example, to specify that the output file should be named *outute*.

```
uteconvert -o outute mytrace
```

To convert a set of AIX trace files into a set of UTE interval files, simply specify the number of files using the **-n** option, and supply the common ″base name″ prefix shared by the files. For example, to convert five trace files with the prefix *mytraces* into UTE interval files, copy the trace files to a common directory and enter:

```
uteconvert -n 5 mytraces
```

You can optionally use the **–o** option to specify a file name prefix for the resulting UTE interval files.

```
uteconvert -n 5 -o outute mytraces
```

When you use the **-n** option, make sure you do not have any old AIX trace files from previous executions of the program still in the directory. The **uteconvert** utility will process the first *n* trace files it finds that match the base name prefix.

For complete reference information on the **uteconvert** utility, refer to its man page in Appendix A, "Parallel environment tools commands," on page 73. If you want to view the statistics information contained in the UTE file(s) in simple tables, refer to "Generating statistics tables from UTE interval trace files" on page 63. If you want to view the statistics information contained in the UTE file(s) graphically, refer to "Converting UTE interval files into SLOG2 files required by Argonne National Laboratory's Jumpshot Tool" on page 64.

Generating statistics tables from UTE interval trace files

Once you have created UTE interval trace files (as described in "Converting AIX trace files into UTE interval trace files" on page 62), you can generate statistical tables from them using the **utestats** utility. In addition to giving you a simple alternative to graphical analysis, the **utestats** utility can help you identify which traces you want to view in a graphical visualization tool like Jumpshot. This is useful, because you are often unable to view all process threads in a graphical visualization tool. Jumpshot, for example, supports only 64 threads. Using the **utestats** utility, you can determine which threads are of interest. In addition, if you do not wish to use a graphical visualization tool, you can analyze traces extensively using the **utestats** utility alone.

By default, six two-dimensional tables are generated. These tables are:

- Time Bin vs. Node
- Thread vs. Event Type
- Event Type vs. Thread
- Node vs. Event Type
- Event Type vs. Node
- Node vs. Processor

The computed statistic for all tables is the sum or the duration. A Node vs. Processor table would look like the following (where tabs have been replaced by spaces to make the column alignment clearer). The unit of measurement is seconds, so, for example, the accumulated duration of all interval records for CPU 1 of node 0 was 2.258315 seconds.

```
node/cpu           0               1
   0            2.823739        2.258315
   1            0.873746        4.241253
   2            0.956515        4.322891
   3            0.853188        4.334650
```

You can generate these statistics tables for a single UTE interval file or multiple UTE interval files. You can also generate these statistics tables for a merged UTE interval file. A merged UTE interval file is one that consists of multiple UTE interval files that have been merged into one file by the **utemerge** utility.

For example, to generate the statistics tables for the UTE interval file *mytrace.ute*, you would enter:

```
utestats mytrace.ute
```

By default, the statistics tables will be printed to standard output. You can, however, redirect them to a file using the **-o** option on the **utestats** command. For example, to redirect the statistics tables output by the **utestats** utility to the file *stattables*, you would enter:

```
utestats -o stattables mytrace.ute
```

As already stated, you can also specify multiple UTE interval files from which the statistics should be generated.

```
utestats mytrace.ute mytrace2.ute mytrace3.ute
```

Rather than specify multiple UTE interval trace file names on the **utestats** command, you could instead use the **utemerge** utility to first merge the multiple UTE interval trace files into a single UTE interval trace file. To do this, you use the

-n option on the **utemerge** command to indicate the number of files you want to merge, and supply the common ″base name″ prefix shared by the files. For example:

```
utemerge -n 3 mytrace
```

The merged UTE interval file generated by the **utemerge** utility will, by default, be named *trcfile.ute*. To specify your own output file name, use the **-o** option.

```
utemerge -n 3 -o mergedtrc.ute mytrace
```

When you use the **-n** option, make sure you do not have any old UTE interval files from previous executions of the program still in the directory. The **utemerge** utility will process the first *n* interval files it finds that match the base name prefix.

You can then generate statistics for the merged UTE interval file using the **utestats** command.

```
utestats mergedtrc.ute
```

For complete reference information on the **utestats** and **utemerge** utilities, refer to their man pages in Appendix A, "Parallel environment tools commands," on page 73.

Note: Argonne National Laboratory's Jumpshot Tool also includes a statistics view feature that displays the same information as the **utestats** command generates. Jumpshot also has the ability to display statistics information graphically. The Jumpshot Tool is described next in "Converting UTE interval files into SLOG2 files required by Argonne National Laboratory's Jumpshot Tool."

Converting UTE interval files into SLOG2 files required by Argonne National Laboratory's Jumpshot Tool

If you would like to view the traces collected by the PCT graphically, you can use the Jumpshot tool developed by Argonne National Laboratory. While Jumpshot is a public domain tool and **not** part of the PE Benchmarker Toolset, we provide a library **— libTraceInput.so —**which is used with the **traceTOslog2** utility for converting UTE interval files into the SLOG2 files required by Jumpshot. You can use the **traceTOslog2** utility to:

- convert a single UTE interval file into a single SLOG2 file.
- merge multiple UTE interval files into a single SLOG2 file.

If you are dealing with a massively parallel job, it is unlikely that you will be able to display all the process threads in Jumpshot. Rather than merge all the trace files generated from such a job, you will instead want to merge selected trace files. To determine which files to merge, you can first use the **utestats** utility (as described in "Generating statistics tables from UTE interval trace files" on page 63) to determine the characteristics of the files. By analyzing the files first using the **utestats** utility, you can determine which files contain the interesting information that you want to merge and view in Jumpshot.

To convert a single UTE interval file into a single SLOG2 file, pass the **traceTOslog2** command the name of the file located in the current directory. For example:

```
traceTOslog2 mytrace.ute
```

By default, the **traceTOslog2** utility appends the suffix *.slog2* to the input filename. Using the **-o** option on the **traceTOslog2** command, however, you can specify an output file name. For example:

```
traceTOslog2 -o mergedtrc.slog2 mytrace.ute
```

To merge multiple UTE interval files into a single SLOG2 file, use the **-n** option to indicate the number of files to merge and pass the **traceTOslog2** utility the common "base name" prefix of the files. For example, to merge 3 files whose prefix is *mytrace*, enter:

```
traceTOslog2 -n 3 mergedtrc.slog2 mytrace
```

When you use the **-n** option, make sure you do not have any old UTE interval files from previous executions of the program still in the directory. The **traceTOslog2** utility will process the first *n* interval files it finds that match the base name prefix.

If you generated traces on a system without access to a switch, then you must use the -g flag when invoking traceTOslog2. In this case, the individual interval files will be merged, but the timestamps may not be correctly synchronized since clocks on individual nodes may not be properly synchronized.

If you want to limit the number of tasks that you want included in the slog2 file, you can use the -s option to specify the set of tasks to be included. The task list is a comma-delimited list of task indices or task ranges. For example, the following command will include trace records from tasks 1, 3, 5, 6, and 7. This example assumes all tasks were run on the same node and therefore are contained within one UTE interval file.

```
traceTOslog2 -o mergedtrc.slog2 -s 1,3,5-7 mytrace
```

For further information about the traceTOslog2 utility, refer to the documentation provided with that utility by Argonne national Laboratory.

You must use the slogmerge utility to generate slog2 files viewable by the latest version of Jumpshot. If you need to generate slog files for viewing with the previous version of Jumpshot, then the slogmerge utility is still available. For complete reference information on the **slogmerge** utility, refer to slogmerge on page 139.

Using the Profile Visualization Tool

The PVT is a postmortem analysis tool. It is designed to process profile data files generated by the PCT used in application profiling. For more information on the PCT, refer to "Using the Performance Collection Tool" on page 36. After processing profile data, you can view the results in the PVT's graphical user interface display. You can also generate report and summary files. The PVT provides a command-line interface to process individual profile files directly into a summary file without initializing the graphic display. The command-line interface also enables you to generate textual profile reports. This section begins with a discussion of the PVT's graphical user interface, followed by a description of the command-line interface.

Using the Profile Visualization Tool's graphical user interface

The PVT provides a graphical user interface that enables you to process profile data files and view the results. The options available in the graphical user interface correspond to the commands available in the PVT's command-line interface. For more information on the command-line interface, refer to "Using the Profile Visualization Tool's command line interface" on page 69.

Profile Visualization Tool (graphical user interface) overview

The PVT's graphical user interface allows you to process and view profile data. You can load one or more files for processing and view the results in a variety of ways. After initializing the graphical user interface, you can choose the appropriate options:

If:	Then:
You wish to load files for processing.	Select **File → Load...**. Doing this opens the Load Files panel. The Load Files panel will enable you to specify what files to load into the tool for processing. You can specify one or more individual profile files, or a summary profile file.
You wish to control the way profile data is presented.	Select the **View** option. Doing this opens the View menu. The View menu will enable you to specify how profile data is presented in the Main Display window. You can specify how to sort data, as well as show function call count and resource usage.
You wish to view selected objects.	Select the **Object** option. Doing this opens the Object menu. The Object menu will enable you to view information such as source code, profile data, and statistics reports for selected objects.
You wish to search for a text string.	Select **File → Find...** Doing this opens the Find panel. The Find panel will enable you to specify the text string for which you want to search.
You wish to generate reports of profile data.	Select the **Report** option. Doing this opens the Report menu. The Report menu will enable you to select and view a variety of reports, including function call count, CPU usage, and memory usage.
You wish to save summary data to a file.	Select **File → Save Statistic Summary...** Doing this opens the Save Statistic Summary panel. This panel will enable you to accept a user-specified file name. The statistic summary data of the input profile file or files will be written to the file.
You wish to export profile data to a file.	Select **File → Export...** Doing this opens the Export panel. This panel will enable you to accept a user-specified file name. The profile data that is currently loaded will be written to the file.

You wish to set user preferences.	Select **File → Preferences...** Doing this opens the Preferences panel. At this time, this panel will enable you to access only one option: source code search paths. There is a text field available that allows you to specify where the source code files reside.
You wish to exit the PVT.	Select **File → Exit...** Doing this closes the Main Display window and exits the PVT.

The following sections describe the graphical user interface in greater detail.

Starting the Profile Visualization Tool

You can start the PVT in either graphical-user-interface (GUI) mode or command-line mode. For instructions on starting the PVT in command-line mode, refer to "Using the Profile Visualization Tool's command line interface" on page 69. To start the PVT in graphical-user-interface mode:

Enter the pvt command at the AIX command prompt.

```
$ pvt
```

Doing this starts the PVT in graphical-user-interface mode and opens its first window – the Main Display.

To start the PVT in graphical-user-interface mode with input profile data loaded and showing in the Main Display window, enter:

```
$ pvt one_or_more_file_names
```

The following figure shows an example of the Main Display window with input profile data loaded.

The Main Display window shows a hierarchical list of all the functions being profiled. The window is divided into two panes, the left one for viewing source code structure and the right one for viewing profile data. Each pane has a corresponding menu: the **Source View** menu and the **Data View** menu. Both the Source View and Data View menus are grayed out if no input file is loaded. The two panes share the same vertical scroll bar and are scrolled together. You can resize the panes horizontally to change their relative proportion in the Main Display window.

The source code structure pane uses ASCII text to show the identifier of each displayed object. The profile data pane represents a selected profile data field, which uses a bar chart to show the profile data associated with each object. The data value is displayed in front of the bar. When you select an object in the source code structure pane, an object menu opens that provides some actions associated with the selected object. You left-click to select an object, and right-click to bring up the selected object's object menu. When you select an object, the **Object** menu in the Main Display window will become available also, providing the same functions as the popup object menu.

If you load a summary profile file to start the GUI, process objects are labeled as **summary process object** in order to distinguish them from the process objects available in an individual profile file. Each function object has a set of statistics records associated with each profile data field.

Following are explanations of the Source View and Data View menus.

Viewing source code structure: The Source View is a drop-down menu with two options: a **Thread-Centric View** and a **Function-Centric View**. The same options are available under the **View** drop-down menu in the Main Display window. See "Viewing program variables" on page 24 for more information. If the input file you are loading to start the GUI is a summary file, there will be no thread information in the file. The structure displayed will be the same no matter which view is used.

Viewing selected profile data: The Data View is a drop-down menu that enables you to change the type of data to be shown in the Main Display window. The Data View menu options include the following categories:

- **Function Call Count**
- **Wall Clock Time**
- **Resource Usage**
- **Hardware Counters**.

You will find similar options available in the **View** drop-down menu. When a particular data type is unavailable in any of the input data files, its corresponding menu option in the View menu is grayed out. The Data View drop-down menu only shows the options that have corresponding values in the input data files. When a set of files is loaded, **Function Call Count** is the default field in the Data View menu.

Accessing the Profile Visualization Tool's online help system

The PVT's graphical user interface has been designed to be intuitive and easy to use. However, if you do have any trouble, you can refer to the PVT's online help system. To access the tool's online help, select **Help → Help Topics** off the main window's menu bar. Many dialogs of the tool also provide **Help** buttons or menu items for starting the help system.

If you open the help from one of the PVT's dialogs, a help topic describing that dialog is displayed. If you open the help from the main window, a task overview topic is displayed.

The PVT help contains topics for each of the major tasks you can perform with the PVT. The left hand pane of the window enables you to navigate the help system to display the needed help topic in the right hand pane. There are three ways to navigate the help system — using the contents tab, using the index tab, or using the search tab:

- the contents tab is displayed by default. Simply click on any entry in the contents tab to display the help topic.
- the index tab shows an index of the entire help system. Simply click on any entry in the index to display its associated help topic. To search the index, type a string in the **Find** field and press **<enter>**. The first index entry containing the string is highlighted. Press **<enter>** again to search for the next occurrence of the string in the index.
- the search tab enables you to search the help for all occurrences of a text string. Simply type the string in the **Find** field and press **<enter>**. A list of all help topics containing the string is displayed. The topics are listed in descending

order according to the number of occurrences of the string. The help topic with the most occurrences of the string is displayed by default.

Using the Profile Visualization Tool's command line interface

The PVT provides a command-line interface that enables you to process profile files directly without initializing the graphical user interface. The subcommands available in the command-line interface correspond to the options available in the graphical user interface. For more information on the graphical user interface, refer to "Using the Profile Visualization Tool's graphical user interface" on page 65.

Profile Visualization Tool (command line interface) overview

The PVT's command-line interface allows you to process profile data directly without using the graphical user interface. After initializing the command-line interface, you can enter the appropriate subcommands that enable you to:

- Load files for processing
- Create a summary file of all the loaded data
- Generate textual reports of profile data
- Export profile data to a file.

The following sections describe the command-line interface in greater detail.

Starting the Profile Visualization Tool in command-line mode

To start the PVT in command-line mode, enter:

```
pvt -c
```

Doing this starts a command-line session without associated profile data. To start a command-line session with associated profile data, enter:

```
pvt -c one_or_more_file_names
```

Once you start a command-line session, the command line prompt changes to **pvt>** and remains this way until you enter the **exit** command to end the command-line session.

The following sections describe the command-line mode subcommands.

Loading files

You can load a set of profile data files into the session with the **load** command. Enter:

```
load one_or_more_file_names
```

If a set of data already exists, then the existing data is discarded and the newly loaded data becomes the current data to be used in future actions.

Creating a summary file

You can create a summary file of all the loaded data with the **sum** command. Enter:

```
sum summary_file_name
```

The merged summary data is written to the file that you specify in the command, with a suffix of *.cdf* being appended to the specified file name.

Generating reports

You can generate textual reports of profile data using the **report** command. You can specify several different options with the report command, depending on what type of output you want. To show a list of available report types, enter:

```
report list
```

The result will look something like:

- **[0] call_count:** function call count report
- **[1] wclock:** wall clock timer report
- **[2] ru_cpu:** CPU usage reports
- **[3] ru_mem:** memory usage report
- **[4] ru_paging:** paging activities reports
- **[5] ru_cswitch:** context switch activities reports
- **[6] pmc_cycle:** instructions per cycle hardware counter reports
- **[7] pmc_fpu:** floating-point hardware counter reports
- **[8] pmc_fxu:** fixed-point hardware counter reports
- **[9] pmc_branch:** branch hardware counter reports
- **[10] pmc_lsu:** load and store hardware counter reports
- **[11] pmc_cache:** cache hardware counter reports
- **[12] pmc_misc:** miscellaneous hardware counter reports

To generate all the available reports to a file, enter:

```
report output_file_name
```

To generate reports by report name to a file, enter:

```
report "one_or_more_report_names" output_file_name
```

For example:

```
report "wclock,ru_cpu" output
```

To generate reports by report id to a file, enter:

```
report "one_or_more_report_ids" output_file_name
```

For example:

```
report "1,2" output
```

The report names or report ids in double quotes must be separated by a comma, with no blank space in between. No matter how many reports are selected in one report command, all the reports are output to a single file specified in the report command.

Exporting files

You can export profile data to a specified file using the **export** command. Enter:

```
export output_file_name
```

A suffix *.txt* will be appended to the specified file name.

The currently loaded profile data is written to the user-specified file in plain text format, so the data can be loaded easily into a spreadsheet tool like Lotus® 1-2-3®. The data that is loaded into the tool can be grouped into the following types of records:

- Profile-session record associated with each process (that is, profile session)
- Individual function or thread records
- Function statistics records.

Exiting the Profile Visualization Tool

You can end a command-line session with the **exit** command. Enter:

```
exit
```

Appendix A. Parallel environment tools commands

This appendix contains the manual pages for the PE tools commands discussed throughout this book. Each manual page is organized into the sections listed below. The sections always appear in the same order, but some appear in all manual pages while others are optional.

NAME
: Provides the name of the command described in the manual page, and a brief description of its purpose.

SYNOPSIS
: Includes a diagram that summarizes the command syntax, and provides a brief synopsis of its use and function. If you are unfamiliar with the typographic conventions used in the syntax diagrams, see "Conventions and terminology used in this book" on page viii.

FLAGS
: Lists and describes any required and optional flags for the command.

DESCRIPTION
: Describes the command more fully than the **NAME** and **SYNOPSIS** sections.

ENVIRONMENT VARIABLES
: Lists and describes any applicable environment variables.

EXAMPLES
: Provides examples of ways in which the command is typically used.

FILES
: Lists and describes any files related to the command.

RELATED INFORMATION
: Lists commands, functions, file formats, and special files that are employed by the command, that have a purpose related to the command, or that are otherwise of interest within the context of the command.

pct

NAME

pct – Invokes the Performance Collection Tool (PCT) in either its graphical-user-interface or command-line mode.

SYNOPSIS

pct [**-c** [**-s** *script_file*]]

The **pct** command starts the PCT in either its graphical-user-interface mode, or, if the **-c** flag is specified, its command-line mode.

FLAGS

-c Specifies that the PCT should be started in command-line mode. Refer to "Subcommands of the pct command" on page 76 for information on the subcommands you can issue once the PCT is running in this mode.

-s *script_file*
When running in command-line mode, instructs the PCT to read its commands from the script file specified. When running in graphical user interface mode, you cannot use this option.

DESCRIPTION

The PCT is a highly scalable performance monitoring tool built on dynamic instrumentation technology — the Dynamic Probe Class Library (DPCL). Using the PCT, you can collect:

- MPI and user event traces for eventual analysis by either:
  - Jumpshot (a public-domain tool developed at Argonne National Lab).

    or
  - the **utestats** utility provided as part of the PE Benchmarker Toolset.

  Since the MPI and user trace information will be output as standard AIX trace files, we have also supplied, as part of the PE Benchmarker tool set, several utilities for converting the AIX trace files created by the PCT into a format readable by Jumpshot and the **utestats** utility.

  POWER5 counter architecture enforces coupling of events to counters. Events can only be counted in specific groups. The following PMAPI hardware counter groups are supported: 0, 7, 8, 10, 36, 40, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 78. 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 128, 129, 130, 131, 132, 133, 134, 135, 136

  Users of POWER5 hardware will only be able to select event groups to count, as opposed to individual events. A counter grouping is a set of events that can be simultaneously counted in a set of counters on a POWER5 box. POWER5 contains 6 hardware counters, two of which are dedicated to specific events, and the other four events specific to the grouping.
- Hardware and operating system profiles for playback within the Performance Visualization Tool (as invoked by the **pvt** command).

The PCT can be run in either its graphical-user-interface mode, or, if the **-c** flag is specified, its command-line mode. The PCT's graphical user interface is built on top of its command-line interface; in other words, your manipulations of the graphical user interface are translated by the tool into **pct** subcommands. These subcommands are issued, and the information returned is used to update the graphical user interface. The **pct** subcommands that result from your interface interactions are displayed in an information area of the PCT's Main Window.

When running in command-line mode, you can optionally have the PCT read its commands from a script file. You can specify the script file using the **-s** option when issuing the **pct** command, or you can use the **run** subcommand.

The **pct** command's subcommands (for controlling the PCT in command-line mode) are listed alphabetically under "Subcommands of the pct command" on page 76.

EXAMPLES

To start the PCT in graphical-user-interface mode:

```
pct
```

To start the PCT in command-line mode:

```
pct -c
```

To start the PCT in command-line mode, and read commands from the script file *myscript.cmd*.

```
pct -c -s myscript.cmd
```

RELATED INFORMATION

Commands: **uteconvert**(1), **pvt**(1), **slogmerge**(1), **utemerge**(1), **utestats**(1)

Refer to traceTOslog2 documentation at

http://www-unix.mcs.anl.gov/perfvis/download/index.htm

Subcommands of the pct command

comment subcommand (of the pct command)

[*comment-string*]

The **comment** subcommand is intended for use within script files you write, and is not intended for interactive command-line sessions. Essentially, the # (pound sign) character instructs the PCT to ignore the rest of the line.

comment-string
Is any comment you want to add to the file.

For example, the following PCT script file contains three comment lines to explain the purpose of the script:

```
# This example uses the 'chaotic' application from the DPCL samples.
# The script loads a four-way chaotic application, inserts probes,
# starts the application, and then waits for the application to complete
load poe exec /home/user/chaotic poeargs "-procs 4"
select trace
trace set path "/scratch/trace_out"
trace add mpiid 0 to file "chaotic.f"
start
wait
```

connect subcommand (of the pct command)

connect [{**pid** *process_id* | **poe pid** *poe_process_id*} | **task** *task_list* | **group** *task_group_name*]

The **connect** subcommand connects the PCT to an existing application. Using this subcommand, you can connect to a single application process, or the controlling, ″home node″ process in a POE application. Once you are connected to a controlling POE home node process, you can reissue this subcommand to connect to one or more of the POE application's tasks.

pid *process_id*
Specifies the process ID of a single application process to connect.

poe pid *poe_process_id*
Indicates that you are connecting a POE process, and specifies the process ID of the POE home node process (the executing instance of the **poe** command). Only the controlling POE process is connected. To connect to one or more of the POE application's tasks, reissue the **connect** subcommand.

task *task_list*
Specifies a list of POE tasks to connect. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refer to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
Specifies the name of a task group. To connect to all tasks in a POE application, you can specify the task group *all*, which will have been

created by the PCT when you connected to the controlling, home node, POE process. Refer to the **group** subcommand for information on creating task groups.

For example, to connect to the application process whose AIX process ID is 12345:

```
pct> connect pid 12345
```

To connect to the POE ″home node″ process whose AIX process ID is 12345:

```
pct> connect poe pid 12345
```

The preceding example connects to just the controlling, home node, process in a POE application. To now connect to all of the tasks in the POE application:

```
pct> connect group all
```

destroy subcommand (of the pct command)

destroy [**task** *task_list* | **group** *task_group_name*]

The **destroy** subcommand terminates execution of one or more connected processes. By default, the tasks in the current task group (as previously defined by the **group** subcommand) are the ones terminated. You can override this default, however, by specifying a *task_list* or *task_group_name* when you issue the **destroy** subcommand.

When working with a POE application, be aware that terminating any process of the application will cause POE to terminate all of the application's processes. This termination of all processes is a function of POE, not of the PCT. For more information, refer to *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*.

task *task_list*
: Specifies the connected tasks to be terminated. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refer to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

For example, to terminate execution of the tasks in the current task group:

```
pct> destroy
```

To terminate task 8:

```
pct> destroy task 8
```

To terminate the tasks in task group *connected*:

```
pct> destroy group connected
```

disconnect subcommand (of the pct command)

disconnect [**task** *task_list* | **group** *task_group_name*]

The **disconnect** subcommand disconnects the PCT from one or more connected processes. Disconnecting from a process removes any performance collection probes from the process. Disconnecting from a process does not terminate the process; the process will continue to run. Once a process is disconnected, the PCT will no longer be able to control execution of, or instrument, the process. By default, the tasks in the current task group (as previously defined by the **group** subcommand) are the ones that are disconnected. You can override this default, however, by specifying a task list or task group name when you issue the **disconnect** subcommand.

task *task_list*
: Specifies the connected POE tasks to be disconnected. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

For example, to disconnect from the tasks in the current task group:

```
pct> disconnect
```

To disconnect from task 8:

```
pct> disconnect task 8
```

To disconnect from the tasks in task group *connected*:

```
pct> disconnect group connected
```

exit subcommand (of the pct command)

exit [**destroy**]

The **exit** subcommand exits the PCT. If you loaded the target application, its process(es) will also be terminated. If you merely connected to the target application, the process(es) will continue to run unless you use the **destroy** clause to explicitly instruct the PCT to kill the connected processes. Since terminating any process of the POE application will cause POE to terminate all of the POE application's processes, the **destroy** clause effectively terminates the entire POE application.

For example, to exit the PCT, but allow all of its connected processes to continue running:

```
pct> exit
```

To exit the PCT and terminate the connected target application processes:

```
pct> exit destroy
```

file subcommand (of the pct command)

file [**task** *task_list* | **group** *task_group_name*] *"regular_expression"*

The **file** subcommand lists, for one or more tasks, any associated source file names that match a regular expression that you supply. By default, this subcommand applies to the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **file** subcommand.

The files are listed by this subcommand as a table with column headings for the task identifier, file identifier, file name, and, if available, the path.

The file identifiers are determined by sorting the files alphabetically and numbering them starting from 0. The path will be shown only if the file path information was supplied when you compiled a file.

task *task_list*
: Specifies the connected POE tasks whose source file names you want to list. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

"regular_expression"
: An AIX regular expression (file name substitution pattern) enclosed in quotation marks that identifies the files to list. The **file** subcommand will filter the list of file names using this regular expression; only file names that match this regular expression pattern will be listed.

For example, to list all the files in the current task group:

```
pct> file "*"
Tid File Id File Name Path
--- ------- --------- -------------
0   0       bar.c     ../../lib/src
0   1       foo1.c    ../../lib/src
0   2       foo2.c    ../src
pct>
```

To list only the files in task 0 that begin with the letter "f"

```
pct> file task 0 "f*"
Tid File Id File Name Path
--- ------- --------- -------------
0   1       foo1.c    ../../lib/src
0   2       foo2.c    ../src
pct>
```

find subcommand (of the pct command)

find [**task** *task_list* | **group** *task_group_name*]
function *"regular_expression_to_match_function_name"*

The **find** subcommand lists all function names that match a regular expression pattern that you supply. This subcommand is intended for situations when you wish to instrument a particular function, but do not know which file contains the function.

The function names found are listed by this subcommand as a table with column headings for task identifier, file identifier, file name, and function name.

task *task_list*
: Specifies the connected POE tasks whose source files you want to search. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

function *"regular_expression_to_match_function_name"*
: An AIX regular expression (file name substitution pattern) enclosed in quotation marks that identifies the functions to locate. Matching is performed using rules of AIX file name pattern matching. The **find** subcommand will filter the list of function names using this regular expression; only function names that match this regular expression pattern will be listed.

For example, to list all the functions in task 0 that match the regular expression *comp**:

```
pct> find task 0 function "comp*"
Tid File Id File Name Function Name
--- ------- --------- -------------
0   23      main.c    compute
0   23      main.c    compare
0   25      sort.c    compare2
pct>
```

function subcommand (of the pct command)

function [**task** *task_list* | **group** *task_group_name*]
{**file** *"regular_expression"*[,*"regular_expression"*] |
fileid *file_identifier*[,*file_identifier*]}...
"regular_expression_to_match_function_name"

The **function** subcommand lists, for one or more tasks, the names of the functions contained in a source file that match a regular expression search pattern you supply. The file whose functions are listed can be specified as a file identifier or as a regular expression that matches the file name. The file information can be ascertained by the **file** subcommand, or, if you are unsure which file the function is located in, the **find** subcommand. By default, this subcommand applies to the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **function** subcommand.

The function names are listed by this subcommand as a table with column headings for task identifier, file identifier, function identifier, file name, and function name.

The function identifiers are determined by sorting the functions contained in a file alphabetically starting from 0. Each file's functions are numbered sequentially starting from 0.

task *task_list*
Specifies the connected POE tasks containing the source files whose functions you want to list. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

file *"regular_expression"*[**,***"regular_expression"*]
Specifies, using one or more regular expression patterns, the file(s) whose functions you want to list. The regular expression patterns must be contained in quotation marks.

fileid *file_identifier*[**,***file_identifier*]
Specifies, using one or more file identifiers as returned by the **file** subcommand, the file(s) whose functions you want to list.

"regular_expression_to_match_function_name"
A regular expression enclosed in quotation marks that identifies the function names to list. Matching is performed using rules of AIX file name pattern matching. The **function** subcommand will filter the list of function names using this expression; only function names (for the tasks/file indicated) that match the regular expression will be listed.

For example, to list all the functions in the file "bar.c" in task 0:

```
pct> function task 0 file "bar.c" "*"
Tid File Id Function Id File Name Function Name
--- ------- ----------- --------- -------------
0   1       0           bar.c     func0
0   1       1           bar.c     func1
pct>
```

To list all the functions in the file "bar.c" (using the file identifier) in task 0:

```
pct> function task 0 fileid 1 "*"
Tid File Id Function Id File Name Function Name
--- ------- ----------- --------- -------------
0   1       0           bar.c     func0
0   1       1           bar.c     func1
pct>
```

To list, for task 0, all of the functions in files beginning with "b" or "d":

```
pct> function task 0 file "b*", "d*" "*"
Tid File Id Function Id File Name Function Name
--- ------- ----------- --------- -------------
0   3       0           bar.c     func0
0   3       1           bar.c     func1
0   3       2           bar2.c    func_xyz
0   4       0           bar2.c    calc
0   4       1           bar2.c    do_math
0   4       2           bar2.c    sum
pct>
```

group subcommand (of the pct command)

group default *task_group_name*

group add *task_group_name task_list*

group delete *task_group_name* [*task_list*]

The **group** subcommand can perform three distinct actions related to task groups:

- Using the **default** action of the **group** command:

  group default *task_group_name*

  you can set the command context on a particular task group. When you do this, the task group you specify becomes the current task group; certain other subcommands that you issue (such as the **file**, **function**, and **point** subcommands) will, by default, apply only to the tasks in the current task group.
- Using the **add** action of the **group** subcommand:

  group add *task_group_name task_list*

  you can create a new task group, or add tasks to an existing task group.
- Using the **delete** action of the **group** subcommand:

  group delete *task_group_name* [*task_list*]

  you can delete, or delete selected tasks from, a task group. If a task list is specified, these tasks are removed from the task group; otherwise, the entire task group is deleted.

In addition to any task groups you create using the **group** subcommand, note that there are two task groups that are created automatically by the PCT when you issue either the **load** or **connect** subcommands. These automatically-created task groups are named *all* and *connected*. The *all* task group contains all tasks in the current application, while the *connected* task group contains the set of tasks to which the PCT is connected.

task_group_name
: refers to the name of the task group that, depending on the particular **group** subcommand action you are executing, you want to:
  - make the default task group
  - create or add tasks to
  - delete or remove tasks from

task_list
: Refers to the list of tasks that, depending on the particular **group** subcommand action you are executing, you want to either add to, or delete from, the task group. The tasks can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

For example, to create a task group *master* consisting of task 0, and a task group *workers* consisting of tasks 1 through 20.

```
pct> group add master 0
pct> group add workers 1:20
```

To add tasks 21 through 30 to the task group *workers*:

```
pct> group add workers 21:30
```

To make the group *workers* the default task group:

```
pct> group default workers
```

To remove tasks 21 through 30 from the task group *workers*.

```
pct> group delete workers 21:30
```

To delete the task group *workers*:

```
pct> group delete workers
```

help subcommand (of the pct command)

help [*command_name*]

The **help** subcommand can either list all of the PCT's subcommands, or else return the syntax of a particular subcommand.

command_name
: refers to the name of the PCT subcommand you want help on.

For example, to get a listing of all of the PCT's subcommands:

```
pct> help
```

To get the syntax of the **load** subcommand:

```
pct> help load
```

list subcommand (of the pct command)

list {[**task** *task_list* | **group** *task_group_name*]
[**file** *"regular_expression"* [,"regular_expression"]... |
fileid *file_identifier*[,*file_identifier*]...] [**line** *line_number_range*]}

list next

The **list** subcommand returns the contents of a file. The first time you issue this subcommand, you should specify a file using the **file** or **fileid** clause. Doing this will list the entire file's contents. To list only a portion of the file's contents, specify a line number range using the **line** clause. To minimize typing, the PCT records the number of the last source code line displayed; issuing the **list next** subcommand will display the next few lines of the source code. By default, this form of the subcommand applies to the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **list** subcommand.

task *task_list*
: Specifies the connected POE tasks containing the source files whose contents you want to list. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a

range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

file *"regular expression"* **[,***"regular expression"***]...**
: Specifies, using one or more regular expressions, the file whose contents you want to list. Only the first file that matches the regular expression(s) will be listed. If this file cannot be located, an error will be returned, regardless of whether a subsequent file match could have been made.

fileid *file_identifier***[,***file_identifier***]...**
: Specifies, using one or more file identifiers as returned by the **file** subcommand, the file(s) whose contents you want to list.

line *line_number_range*
: The line number range of the source code you want to list. Use a colon to separate the ends of the range (for example 1:20).

next
: displays the next few lines of source code after the range previously returned by the **list** subcommand.

For example, to list lines 1 through 20 of the source file *bar.c*:

```
pct> list file "bar.c" line 1:20
```

To then list the next few lines in *bar.c*:

```
pct> list next
```

load subcommand (of the pct command)

load {{[**poe**] **exec** *executable_name* } | {**poe**
[**mpmdcmd** *path_to_poe_commands_file*] [**poeargs** *"poe_arguments_string"*]}
[**args** *"program_arguments_string"*] [**stdout** *standard_out_file_name*]
[**stderr** *standard_error_file_name*] [**stdin** *standard_input_file_name*]

The **load** subcommand loads a serial or POE application for execution. Once an application is loaded, you can instrument it with probes, or control its execution using the **start**, **suspend**, **resume**, and **destroy** subcommands. The **load** subcommand is intended for applications that are not already executing; to connect to applications that are already executing, use the **connect** subcommand. The **poe** clause indicates that the application is a POE application; if not specified, the **load** subcommand assumes you are loading a serial application. The **load** subcommand loads the application into memory in a "stopped state" with execution suspended at its first executable instruction. You can start execution of the application using the **start** subcommand.

poe
: Specifies that you are loading a POE program.

exec *executable_name*
: Specifies the name of the executable file. If you are loading a POE application, you must also include the keyword **poe** on the command line.

mpmdcmd *path_to_poe_commands_file*
: Specifies that the POE program you're loading follows the Multiple Program Multiple Data (MPMD) model and indicates the path to the POE

commands file listing the executable programs to run. For more information on POE commands files, refer to the manual *IBM Parallel Environment for AIX: Operation and Use, Volume 1*.

poeargs *"poe_arguments_string"*
: Specifies command-line arguments that are passed to the **poe** command to control various aspects of the Parallel Operating Environment. For a complete listing of the POE arguments you can supply, refer to the manual *IBM Parallel Environment for AIX: Operation and Use, Volume 1*. The POE arguments should be provided as a string delimited by double quotation marks. Embedded quotation marks can be included in the string if each mark is preceded by an escape character (\). Embedded escape characters may also be included if they are preceded by an additional escape character.

args *"program_arguments_string"*
: Specifies command-line arguments that are passed to the application. Note that these are not POE arguments, which are instead specified by using the **poeargs** clause. The program arguments should be provided as a string delimited by double quotation marks. Embedded quotation marks can be included in the string if each mark is preceded by an escape character (\). Embedded escape characters may also be included if they are preceded by an additional escape character.

stdout *standard_out_file_name*
: Redirects the target application's standard output to the file specified.

stderr *standard_error_file_name*
: Redirects the target application's standard error to the file specified.

stdin *standard_input_file_name*
: Reads the target application's standard input from a file.

For example, the following command loads the serial executable *foo* and passes it the argument string *"a b c"*:

```
pct> load exec /u/example/bin/foo args "a b c"
```

The following command loads the POE executable *parallel_foo* and passes it POE arguments:

```
pct> load poe exec /u/example/bin/parallel_foo poeargs \
"-procs 4 -hfile /tmp/host.list"
```

The following command loads an MPMD POE program. The executable files to load are listed in the POE commands file */u/example/bin/foo.cmds*:

```
pct> load poe mpmdcmd /u/example/bin/foo.cmds poeargs \
"-procs 3 -hfile /tmp/host.list"
```

point subcommand (of the pct command)

point [**task** *task_list* | **group** *task_group_name*]
{**file** *"regular_expression"*[,*"regular_expression"*]... |
fileid *file_identifier*[,*file_identifier*]...}
[**function** *"regular_expression"*[,*"regular_expression"*]... |
funcid *function_identifier*[,*function_identifier*]...]

Lists the instrumentation points (at the file or function level) where custom user markers can be added by the **trace add** subcommand. You only need to identify instrumentation points when installing custom user markers using the **trace add** subcommand. You do not need the instrumentation point information if installing MPI trace probes using the **trace add** subcommand or profile probes using the **profile add** subcommand. By default, this subcommand will list the instrumentation points for the tasks in the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **point** subcommand. The **file** or **fileid** clause specifies the file(s) whose instrumentation points you want listed. Using the **function** clause, you can specify one or more functions whose instrumentation points you want listed.

The instrumentation points are listed by this subcommand as a table with headings for task identifier, file identifier, function identifier, point identifier, point type, and callee name.

The point identifiers are determined by numbering the points, starting from 0, according to their location in each function. The first instrumentation point in the function is given the identifier 0, the second is given the identifier 1, and so on. Each function's instrumentation points are numbered separately starting from 0.

task *task_list*
: Specifies the connected POE tasks whose instrumentation points you want to list. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

file *"regular_expression"***[,***"regular_expression"***]...**
: Specifies, using one or more regular expressions (file name substitution patterns), the file(s) whose instrumentation points you want to list. The regular expression(s) must be contained in quotation marks.

fileid *file_identifier***[,***file_identifier***]...**
: specifies, using one or more file identifiers as returned by the **file** subcommand, the file(s) whose instrumentation points you want to list.

function *"regular_expression"***[,***"regular_expression"***]...**
: Specifies, using one or more regular expressions, the function(s) whose instrumentation points you want to list. This regular expression must be contained in quotation marks.

funcid *function_identifier***[,***function_identifier***]...**
: Specifies, using one or more function identifiers as returned by the **function** subcommand, the function(s) whose instrumentation points you want to list.

For example, to list all the instrumentation points in task 0 for the file *bar.c*:

```
pct> point task 0 file "bar.c"
Tid File Id Function Id Point Id Point Type Callee Name
--- ------- ----------- -------- ---------- -----------
0   54      0           0        0
0   54      0           1        2          printf
0   54      0           2        3          printf
0   54      0           3        2          MPI_Abort
0   54      0           4        3          MPI_Abort
```

```
0   54      0           5        1
0   54      1           0        0
0   54      1           1        2          printf
0   54      1           2        3          printf
0   54      1           3        2          printf
0   54      1           4        3          printf
0   54      1           5        2          MPI_Recv
0   54      1           6        3          MPI_Recv
0   54      1           7        2          consume_data
0   54      1           8        3          consume_data
0   54      1           9        2          printf
0   54      1           10       3          printf
0   54      1           11       1
pct>
```

profile add subcommand (of the pct command)

profile add [**task** *task_list* | **group** *task_group_name*]
{{**profname** *profile_type_name* | **profid** *profile_type_identifier*}
[**groupid** *group_identifier* | **groupname** *group_name*]}...
to {**file** *"regular_expression"*[,*"regular_expression"*]... |
fileid *file_identifier*[,*file_identifier*]...}
[**function** *"regular_expression"*[,*"regular_expression"*]...|
funcid *function_identifier*[,*function_identifier*...]]

The **profile add** subcommand adds one or more probes to collect hardware and operating system profile information. You cannot use this subcommand, or any of the **profile** subcommands, unless you have specified that you are collecting profile data. To specify that you are collecting profile data, issue the **select** subcommand with its **profile** clause:

```
select profile
```

If you add multiple profile probes, be aware that they are considered a single set of probes. When removing profile probes using the **profile remove** subcommand, you will not be able to remove individual probes. Instead, you'll have to remove the entire set of probes.

By default, this subcommand will add the probe(s) to the tasks in the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **profile add** subcommand. Be aware, however, that the set of tasks cannot include different executables in an MPMD application. For example, if an MPMD application consists of executables *a.out* and *b.out*, then this command cannot be applied to a task group that contains both *a.out* and *b.out* tasks.

task *task_list*
: Specifies the connected POE tasks to which you want to add the profile probes. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

profname *profile_type_name*
: Specifies, using a probe type name, a profile probe type to add. To list the profile probe type names, use the **profile show** subcommand (with its **probetypes** clause specified):

```
pct> profile show probetypes
```

profid *profile_type_identifier*
: Specifies, using a probe type identifier, a profile probe type to add. To list the profile probe type identifiers, use the **profile show** subcommand (with its **probetypes** clause specified):

```
pct> profile show probetypes
```

groupid *group_identifier*
: If you are collecting hardware counter information, a profile group identifier indicating the specific hardware counter information you want to collect. To get a list of the profile groups available for your hardware, use the command:

```
pct> profile show probetype hwcount
```

groupname *group_name*
: If you are collecting hardware counter information, a profile group name indicating the specific hardware counter information you want to collect. To get a list of the profile groups available for your hardware, use the command:

```
pct> profile show probetype hwcount
```

file *"regular_expression"***[,***"regular_expression"***]...**
: Specifies, using one or more regular expressions (file name substitution patterns), the file(s) you wish to instrument with profile probes. The regular expressions must be enclosed in quotation marks.

fileid *file_identifier***[,***file_identifier***]...**
: Specifies, using one or more file identifiers as returned by the **file** subcommand, the file(s) you wish to instrument with profile probes.

function *"regular_expression"***[,***"regular_expression"***]...**
: Specifies, using one or more regular expressions, the functions you wish to instrument with the profile probes. The regular expression must be enclosed in quotation marks.

funcid *function_identifier***[,***function_identifier***]...**
: Specifies, using one or more function identifiers as returned by the **function** subcommand, the functions you wish to instrument with the profile probes.

For example, to add a profile probe to collect wall clock data for the current task group:

```
pct> profile add profname wclock to fileid 5 funcid 3
```

To add a profile probe to collect wall clock data, and hardware data using counter group 2:

```
pct> profile add profname wclock profname hwcount groupid 2 to fileid 3
```

profile help subcommand (of the pct command)

profile help [*profile_command_name*]

The **profile help** subcommand can either list all of the PCT's profile subcommands, or else return the syntax of a particular profile subcommand.

Note: You cannot use this subcommand, or any of the profile subcommands, unless you have specified that you are collecting profile data. To specify that you are collecting profile data, issue the **select** subcommand with its profile clause: **select profile**

profile_command_name
: refers to the name of the PCT profile subcommand you want help on.

For example, to get a listing of all of the PCT's

profile subcommands:

```
pct> profile help
```

To get the syntax of the **profile add** subcommand:

```
pct> profile help add
```

profile remove subcommand (of the pct command)

profile remove probe *probe_index*

The **profile remove** subcommand removes the profile probe set specified by the supplied *probe_index*. A profile probe set consists of one or more probes as previously installed by the **profile add** subcommand. An installed profile probe's *probe_index* can be ascertained by the **profile show** subcommand (with its **probes** clause) as in:

```
pct> profile show probes
```

probe *probe_index*
: Specifies, using a probe index, the profile probe set to be removed. The probe index can be ascertained by issuing the **profile show** subcommand with its **probes** clause.

For example, to remove the profile probe set whose index is 3:

```
pct> profile remove probe 3
```

profile set path subcommand (of the pct command)

profile set path *"path_name/output_file_base_name"*

The **profile set path** subcommand specifies the output location and base name for the profile data files generated by profile probes that you install using the **profile add** subcommand.

"path_name/output_file_base_name"
: specifies a relative or full path to the desired location for the profile output files, followed by the output file base name. The base name is needed because the data collected by the PCT will be saved as a file on each host machine where a connected process with probes is running. The file name will consist of the base name you supply followed by a node-specific suffix supplied by the PCT. If a relative path is specified, note that the location will be relative to the directory where you started the PCT.

For example, to specify the relative path *profile* as the location for profile output files and *output* as the base name:

```
pct> profile set path "profile/output"
```

profile show subcommand (of the pct command)

profile show {**probes** | **probetypes** | **probetype** *probe_type_name* | **path**}

The **profile show** subcommand lists, depending on the clause you specify, either the currently installed profile probes, the list of profile probe types that you can install, the options for a probetype, or the profile file output location.

probes
: Specifies that the **profile show** subcommand should list the currently installed profile probes (including the probe index). The probe index information is needed when removing a profile probe using the **profile remove** subcommand.

probetypes
: Specifies that the **profile show** subcommand should list the available probe types you can add using the **profile add** subcommand.

probetype *probe_type_name*
: Specifies that the subcommand should list the options for the specified probe type. Currently, only the hardware counter probe type has options.

path
: Specifies that you want the **profile show** subcommand to return the profile file output location and base name as set by the **profile set path** subcommand.

For example, to list the installed profile probes:

```
pct> profile show probes
```

To list available profile probe types:

```
pct> profile show probetypes
Prof Id Prof Name Description
------- --------- ----------------
0       wclock    wall clock
1       rusage    resource usage
2       hwcount   hardware counter
pct>
```

resume subcommand (of the pct command)

resume [**task** *task_list* | **group** *task_group_name*]

The **resume** subcommand resumes execution of one or more processes that have previously been suspended by the **suspend** subcommand. By default, the tasks in the current task group (as previously defined by the **group** subcommand) are the ones that have their execution resumed. You can override this default, however, by specifying a task list or task group name when you issue the **resume** subcommand.

task *task_list*
: Specifies the connected POE tasks that you want to resume executing. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by

giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

For example, to resume execution of all tasks in the current task group:

```
pct> resume
```

To resume execution of tasks 0 through 20:

```
pct> resume task 0:20
```

To resume execution of the tasks in task group *mygroup*:

```
pct> resume group mygroup
```

run subcommand (of the pct command)

run *"pct_script_file"*

The **run** subcommand executes a series of PCT commands that are stored in a "PCT script file". A PCT script file is an ASCII file that lists a sequence of PCT subcommands. Each PCT subcommand is placed on a separate line in the PCT script file. Lines beginning with a # (pound sign) character are comments and will not be executed by the PCT.

"pct_script_file"
: Specifies the name of the PCT script file whose subcommands you want to execute. The file name must be enclosed in quotation marks.

For example, to execute the PCT subcommands contained in the PCT script file *myscript.cmd*:

```
pct> run "myscript.cmd"
```

select subcommand (of the pct command)

select {**trace** | **profile**}

The **select** subcommand enables you to select the type of probe data you will be collecting.

trace Specifies that you intend to collect MPI or custom user event traces for eventual analysis using Jumpshot or the **utestats** utility.

profile
: Specifies that you intend to collect hardware and operating system profiles for analysis using the Profile Visualization Tool.

For example, if you will be adding trace probes (using the **trace add** subcommand) for collecting MPI or custom user event data:

```
pct> select trace
```

If, on the other hand, you will be adding profile probes (using the **profile add** subcommand) for collecting hardware and operating system profiles:

```
pct> select profile
```

set subcommand (of the pct command)

set sourcepath [**relative**] *"path_list"*

The **set** subcommand enables you to set the path used when displaying the contents of a file using the **list** subcommand. The initial value for the source path is the directory in which the tool was started.

relative
Specifies that, if relative path information is included as part of the file name supplied to the **list** subcommand, the relative path should be used together with the directories listed in the *pathlist*.

For example, say one of the source files in the application is named *"../../myapp/src/compute.c"* and the source path is *"/tmp:/usr/tmp:/home/mydir/examples/yourapp"*. If the **relative** keyword is used when setting the source path, the PCT searches the following directories when the **list /../../myapp/src/compute.c** subcommand is issued.

```
/tmp/../../myapp/src/
/usr/tmp/../../myapp/src/
/home/mydir/examples/yourapp/../../myapp/src/
```

If the **relative** keyword is not used when setting the source path, however, the following directories are searched:

```
/tmp/
/usr/tmp/
/home/mydir/examples/yourapp/
```

"path_list"
A colon-delimited list that specifies the path the **list** subcommand will use to search for source files.

show subcommand (of the pct command)

show { **events** | **group** *task_group_name* |
groups | **points** | **ps** | **sourcepath** |
tools }

The **show** subcommand returns, depending on the form of the subcommand you use, various information about the target application and the PCT.

- Using the form **show events** returns a list of the possible events that, if you place the PCT in an event loop using the **wait** subcommand, can break the PCT out of the loop. Be aware that the **wait** subcommand is intended only for use within scripts you write, and is not intended for interactive command-line sessions.
- Using the form:

  show group *task_group_name*

  returns, for each task in the specified task group, the task identifier, the program name, the name of the host machine on which the task is running, the CPU type, and the task state.
- Using the form:

  show groups

returns a list of task groups. This includes any task groups created by default (the task groups *all* and *connected*), and any task groups you created using the **group** subcommand. An ampersand character (@) is displayed to the right of the default task group.

- Using the form:

  show points

  returns a list of the available instrumentation point types. This enables you to understand the numeric point type returned by the **point** subcommand.
- Using the form:

  show ps

  returns a list of the processes you own on the node where you started the PCT. This information is needed when connecting to an application using the **connect** subcommand.
- Using the form:

  show sourcepath

  returns a list of directories searched when displaying the contents of a file using the **list** subcommand. You can set the source path using the **set** subcommand.
- Using the form:

  show tools

  returns a list of the types of information you can collect using the PCT (for this release, "trace" and "profile"). This information is needed when selecting the type of data you will be collecting using the **select** subcommand.

For example, to show the tasks in the current task group:

```
pct> show group
```

To show the tasks in the task group "connected":

```
pct> show group connected
```

To show the processes that you own on the host machine:

```
pct> show ps
```

start subcommand (of the pct command)

start

The **start** subcommand starts execution of an application you have loaded using the **load** subcommand. (The **load** subcommand loads an application into memory in a "stopped state" with execution suspended at the first executable instruction.)

For example, to start execution of the currently-loaded application:

```
pct> start
```

stdin subcommand (of the pct command)

stdin [{"*string*" | **eof**}]

The **stdin** subcommand sends the supplied string as standard input to the currently loaded application. If no string is supplied, the **stdin** subcommand will send a newline character to the application. If the **eof** option is supplied, the **stdin** subcommand will send an end-of-file character to the application.

Be aware that this subcommand is intended only for applications that you have loaded using the **load** subcommand. If you have instead connected to an application using the **connect** subcommand, you cannot send standard input text using the **stdin** subcommand.

Also be aware that you can, when loading an application using the **load** subcommand, indicate that the application should read standard input from a file specified by the **stdin** option. If the **stdin** option is used when loading an application with the **load** subcommand, note that the **stdin** subcommand cannot be used.

"string"
: Specifies a text string to send to standard input. The string should be enclosed in quotes, and embedded formatting characters (such as \n) are permitted. If no string is supplied, the **stdin** subcommand will send a newline character to the application.

eof
: sends an end-of-file character to the input stream reading this input data.

For example:

```
pct> stdin "now is the time \nfor all good men"
```

suspend subcommand (of the pct command)

suspend [**task** *task_list* | **group** *task_group_name*]

The **suspend** subcommand suspends execution of one or more processes. By default, the tasks in the current task group (as previously defined by the **group** subcommand) are the ones that are suspended. You can override the default, however, by specifying a task list or task group name when you issue the **suspend** subcommand. You can resume execution of tasks suspended by this subcommand by issuing the **resume** subcommand.

task *task_list*
: Specifies the connected POE tasks that you want to suspend. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

For example, to suspend execution of all tasks in the current task group:

```
pct> suspend
```

To suspend execution of tasks 0 through 20:

```
pct> suspend task 0:20
```

To suspend execution of the tasks in task group *"mygroup"*:

```
pct> suspend group mygroup
```

trace add subcommand (of the pct command)

trace add [**task** *task_list* | **group** *task_group_name*]
{**mpiid** *probetype_number_list* | **mpiname** *probe_name_list*} **to**
{**file** *"regular_expression"*[,*"regular_expression"*]... |
fileid *file_identifier*[,*file_identifier*]... }
[**function** *"regular_expression"*[,*"regular_expression"*]... |
funcid *function_identifier*[,*function_identifier*]...]

trace add [**task** *task_list* | **group** *task_group_name*]
{**simplemarker** *"marker_name"* |
{{**beginmarker** | **endmarker**} *"marker_name"*}
| {**traceon** | **traceoff**}} **to** {**file** *"regular_expression"*[,*"regular_expression"*]... |
fileid *file_identifier*[,*file_identifier*]... }
{**function** *"regular_expression"*[,*"regular_expression"*]... |
funcid *function_identifier*[,*function_identifier*]...} **pointid** *point_identifier*

The **trace add** subcommand enables you to add the following types of probes to one or more tasks. You can add:

- MPI trace probes. If you add multiple MPI trace probes, be aware that they are considered a single set of probes. When removing MPI trace probes using the **trace remove** subcommand, you will not be able to remove selected probes. Instead, you'll have to remove the entire set of probes.
- simple user markers to trace events of interest
- begin user markers and end user markers to trace intervals of interest
- user markers to force tracing on and off

You cannot use this subcommand, or any of the trace subcommands, unless you have specified that you are collecting trace data. To specify that you are collecting trace data, issue the **select** subcommand with its **trace** clause:

```
pct> select trace
```

You also need to specify the output location and a "base name" prefix for the trace files. To do this, use the **trace set path** command. For example:

```
pct> trace set path "/home/timf/tracefiles/mytrace"
```

By default, this subcommand will add the probes to the tasks in the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **trace add** subcommand. Be aware, however, that the set of tasks cannot include different executables in an MPMD application. For example, if an MPMD application consists of executables *a.out* and *b.out*, then this command cannot be applied to a task group that contains both *a.out* and *b.out* tasks.

task *task_list*
: Specifies the connected POE tasks to which you want to add the trace probes or user markers. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

mpiid *probetype_number_list*
: A probe identifier (or a list of comma-separated probe identifiers) indicating the type of MPI data (collective communication, point-to-point communication, one-sided operations, and so on) that you want to collect. To get a list of the probe identifiers, issue the **trace show** subcommand with its **probetypes** clause as in:

```
pct> trace show probetypes
```

mpiname *probe_name_list*
: A probe name (or a list of comma-separated probe names) indicating the type of MPI data (collective communication, point-to-point communication, one-sided operations, and so on) that you want to collect. To get a list of the probe names, issue the **trace show** subcommand with its **probetypes** clause as in:

```
pct> trace show probetypes
```

simplemarker *"marker_name"*
: Indicates that the probe is a simple marker being placed in the target application to trace a particular event of interest. A simple marker appears in the trace record as a single point.

{beginmarker | endmarker} *"marker_name"*
: Specifies that the probe is a user marker that marks either the beginning or ending of a named user state. You need to mark both the beginning and ending of the range with the same *"marker_name"* (a string that will be used to identify the user state in the trace record). You can only use a particular marker name for one begin marker/end marker pair. The state will appear in the trace record as a region.

{traceon | traceoff}
: Specifies that the probe is a user marker that will either force tracing on or off. This provides a finer degree of trace control than is otherwise available when merely specifying the file and function to trace.

file *"regular_expression"***[,***"regular_expression"***]...**
: Specifies, using one or more regular expressions (file name substitution patterns), the file(s) you wish to instrument. The regular expression must be contained in quotation marks.

fileid *file_identifier***[,***file_identifier***]...**
: Specifies, using one or more file identifiers as returned by the **file** subcommand, the files you wish to instrument.

function *"regular_expression"***[,***"regular_expression"***]...**
: Specifies, using one or more regular expressions, the function(s) you want to instrument.

funcid *function_identifier***[,***function_identifier***]...**
: Specifies, using one or more function identifiers as returned by the **function** subcommand, the function you want to instrument.

pointid *point_identifier*
: Specifies, using a point identifier, the instrumentation point at which to add the user markers.

For example, to trace all MPI events in the file *"bar.c"*:

```
pct> trace add mpiname all to file "bar.c"
```

To add a begin state marker named *"green"* to the second point of the first function of file *"foo.c"*:

```
pct> trace add beginmarker "green" to file "foo.c" funcid 0 pointid 1
```

trace help subcommand (of the pct command)

trace help [*trace_command_name*]

The **trace help** subcommand can either list all of the PCT's trace subcommands, or else return the syntax of a particular trace subcommand.

Note: You cannot use this subcommand, or any of the trace subcommands, unless you have specified that you are collecting trace data. To specify that you are collecting trace data, issue the **select** subcommand with its trace clause: **select trace**

trace_command_name
refers to the name of the PCT trace subcommand you want help on.

For example, to get a listing of all of the PCT's trace subcommands:

```
pct> trace help
```

To get the syntax of the **trace add** subcommand:

```
pct> trace help add
```

trace remove subcommand (of the pct command)

trace remove {**marker** *marker_id* | **probe** *probe_index*}

The **trace remove** subcommand enables you to remove a custom user marker or a trace probe set.

marker *marker_id*
Specifies the marker identifier of the custom user marker you want to remove. To ascertain the marker identifier, use the **trace show** subcommand with its **markers** clause.

```
pct> trace show markers
```

probe *probe_index*
Specifies, using a probe index, the trace probe set you wish to remove. A trace probe set consists of one or more probes previously installed by the **trace add** subcommand. To ascertain the trace probe set you wish to remove, use the **trace show** subcommand with its **probes** clause as in:

```
pct> trace show probes
```

For example, to remove the trace probe whose probe identifier is "2":

```
pct> trace remove probe 2
```

trace set subcommand (of the pct command)

trace set { **path** *"path_name/output_file_base_name"* | [**bufsize** *buffer_size*] [{**event** {**mpi** | **process** | **idle**} | {**event** [**mpi,**] [**process,**] [**idle**]}] [**logsize** *maximum_log_size*]}

The **trace set** subcommand enables you to specify various settings for event trace collection. You cannot use this subcommand, or any of the trace subcommands, unless you have specified that you are collecting trace data. To specify that you are collecting trace data, issue the **select** subcommand with its **trace** clause:

```
select trace
```

The settings you make with this subcommand will stay in effect until you issue the **select** subcommand.

path *"path_name/output_file_base_name"*
: Specifies a relative or full path name to the desired location for trace files followed by the output file base name. The base name is needed because the data collected by the PCT will be stored as a file on each host machine where a connected process with probes is running, The file name will consist of the base name you supply followed by a node specific suffix supplied by the PCT.

bufsize *buffer_size*
: Specifies the AIX trace buffer size in Kilobytes. This value can be at most 1024, which is also the default value.

[{event {mpi | process | idle} | {event [mpi,] [process,] [idle]}]
: Specifies the type of events (MPI events, process dispatch events, and CPU idle events) that are traced. By default, MPI events and process dispatch events are traced. Tracing process dispatch events and CPU idle events can result in larger trace files, but the additional information can provide useful context for the MPI information collected.

: If you want to specify more than one event type, use a comma to separate the event type names.

logsize *maximum_log_size*
: Specifies the maximum trace file size in Megabytes. The default is 20 M.

For example, to specify the directory tracefiles/mytrace as the output directory for the trace files:

```
pct> trace set path "tracefiles/mytrace"
```

To specify the buffer size to be 900 K:

```
pct> trace set bufsize 900
```

To specify the maximum trace file size to be 25 M:

```
pct> trace set logsize 25
```

To specify that CPU idle events should be collected:

```
pct> trace set event idle
```

To specify that MPI and CPU idle events should be collected:

```
pct> trace set event mpi, idle
```

trace show subcommand (of the pct command)

trace show {[**task** *task_list* | **group** *task_group_name*] {**markers** | **probes**} | **probetypes** | **path**| options}

The **trace show** subcommand lists, depending on the clause you specify, either:

- the currently installed trace probes:

trace show [**task** *task_list* | **group** *task_group_name*] **probes**

- the currently installed user markers:

  trace show [**task** *task_list* | **group** *task_group_name*] **markers**

- the list of available probe types you can add using the **trace add** subcommand:

  trace show probetypes

- the trace file output location and base name (as set by the **trace set path** subcommand):

  trace show path

- the BufSize, LogSize and Event:

  trace show options

When listing the currently installed trace probes or user markers, the action is performed for the tasks in the current task group (as previously defined by the **group** subcommand). You can override this default, however, by specifying a task list or task group name when you issue the **trace show** subcommand.

task *task_list*
: Specifies the connected POE tasks whose trace probes or user markers you want to list. The tasks in the POE application can be specified by listing individual values separated by commas (1,3,8,9), by giving a range of tasks using a colon to separate the ends of the range (12:15 refers to tasks 12, 13, 14, and 15), by giving a range and increment value using colons to separate the range and increment values (20:26:2 refers to tasks 20, 22, 24, and 26), or by using a combination of these (12:18,22,30).

group *task_group_name*
: Specifies the name of a task group. Refer to the **group** subcommand for information on creating task groups.

markers
: Specifies that you want the **trace show** subcommand to list the currently installed user markers.

options
: Specifies that you want the trace show subcommand to list the current settings for BufSize, LogSize and Event.Specifies.

probes
: Specifies that you want the **trace show** subcommand to list the currently installed trace probes.

probetypes
: Specifies that you want the **trace show** subcommand to list the available trace probe types you can add using the **trace add** subcommand.

path
: Specifies that you want the **trace show** subcommand to return the trace file output location and base name as set by the **trace set path** subcommand.

For example, to list the trace probes installed in the tasks in the current task group:

```
pct> trace show probes
```

To list the user markers for the tasks in the task group "workers":

```
pct> trace show markers
```

To list the available probe types:

```
pct> trace show probetypes
```

wait subcommand (of the pct command)

wait

The **wait** subcommand blocks the PCT's execution so that it can wait for asynchronous system events (such as a task terminating) to occur. When one of these asynchronous events occurs, the PCT resumes execution, and returns the event that occurred. Be aware that this command is intended only for use within scripts you write, and is not intended for interactive command-line sessions. If you use it during an interactive command-line session, the only way to break out of the loop is to press **<control>-C** which will kill the PCT.

To see a list of the possible events that can resume execution of the PCT, issue the subcommand:

```
pct> show events
```

For example, the following example blocks execution of the PCT. Execution of the PCT resumes when the target application terminates. The PCT returns the event name "*app_term*":

```
pct> wait
app_term
```

pdbx

NAME

pdbx – Invokes the **pdbx** debugger, which is the command-line debugger built on **dbx**.

SYNOPSIS

pdbx [*program* [*program_options*]] [*poe options*]
[**-c** *command_file*]
[**-d** *nesting_depth*]
[**-E** *DebugEnv*
[**-E** *DebugEnv*]...]
[**-I** *directory*
[**-I** *directory*]...]
[**-F**]
[**-x**]

pdbx -a *poe process id*
[*limited poe options*]
[**-c** *command_file*]
[**-d** *nesting_depth*]
[**-I** *directory*
[**-I** *directory*]...]
[**-F**]
[**-x**]

pdbx -h

The **pdbx** command invokes the **pdbx** debugger. This tool is based on the **dbx** debugger, but adds function specific to parallel programming.

FLAGS

Because **pdbx** runs in the Parallel Operating Environment, it accepts all the flags supported by the **poe** command.

Note: **poe** uses the **PATH** environment variable to find the program, while **pdbx** does not.

See the **poe** manual page in *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment* for a description of these options. Additional **pdbx** flags are:

-a Attaches to a running **poe** job by specifying its process id. This must be executed from the node where the **poe** job was initiated. When using the debugger in attach mode there are some debugger command line arguments that should not be used. In general, any arguments that control how the partition is set up or specify application names and arguments should not be used.

-c Reads startup commands from the specified *commands_file*.

-d
Sets the limit for the nesting of program blocks. The default nesting depth limit is 25.

-E
: This flag can be used to specify an environment variable and its value which will be set for the remote task. The **-E** flag must be specified multiple times to specify multiple environment variables. This flag has no effect when used in combination with the **-a** flag.

  Note: **poe** sets up some environment variables for the remote task which could be overriden using the **pdbx -E** flag. To resolve this, it may be necessary to check the environment of the remote task with and without the **pdbx -E** flag.

-F This flag can be used to turn off *lazy reading* mode. Turning lazy reading mode off forces the remote **dbx** sessions to read all symbol table information at startup time. By default, lazy reading mode is on.

Lazy reading mode is useful when debugging large executable files, or when paging space is low. With lazy reading mode on, only the required symbol table information is read upon initialization of the remote **dbx** sessions. Because all symbol table information is not read at **dbx** startup time when in lazy reading mode, local variable and related type information will not be initially available for functions defined in other files. The effect of this can be seen with the **whereis** command, where instances of the specified local variable may not be found until the other files containing these instances are somehow referenced.

-h
: Writes the **pdbx** usage to STDERR then exits. This includes **pdbx** command line syntax and a description of **pdbx** options.

-I (upper-case i)
: Specifies a *directory* to be searched for an executable's source files. This flag must be specified multiple times to set multiple paths. (Once **pdbx** is running, this list can be overridden on a group or single node basis with the **use** subcommand.)

-x Prevents **dbx** from stripping _ (trailing underscore) characters from symbols originating in Fortran source code. This flag enables **dbx** to distinguish between symbols which are identical except for an underscore character, such as xxx and xxx_.

DESCRIPTION

pdbx is the Parallel Environment's command-line debugger for parallel programs. It is based, and built, on the AIX debugging tool **dbx**.

pdbx supports most of the familiar **dbx** subcommands, as well as additional **pdbx** subcommands.

To use **pdbx** for interactive debugging you first need to compile the program and set up the execution environment as you would to invoke a parallel program with the **poe** command. Your program should be compiled with the **-g** flag in order to produce an object file with symbol table references. It is also advisable to not use the optimization option, **-O**. Using the debugger on optimized code may produce inconsistent and erroneous results. For more information on the **-g** and **-O** compiler options, refer to their use on other compiler commands such as **cc** and **xlf**. These compiler commands are described in *AIX 5L Commands Reference*

pdbx maintains **dbx's** command-line interface and subcommands. When you invoke **pdbx**, the **pdbx** command prompt displays to mark the start of a **pdbx** session.

When using **pdbx**, you should keep in mind that **pdbx** subcommands can either be context sensitive or context insensitive. In **pdbx**, context refers to a setting that controls which task(s) receive the subcommands entered at the **pdbx** command prompt. A default command context is provided which contains all tasks in your partition. You can, however, set the command context on a single task or a group of tasks you define. Context sensitive subcommands, when entered, only affect those tasks in the current command context. Context insensitive subcommands are not affected by the command context setting.

If you are already familiar with **dbx**, you should be aware that some **dbx** subcommands behave somewhat differently in **pdbx**. Be aware that:
- all the **dbx** subcommands are context sensitive in **pdbx**. If you use the **stop** subcommand, for example, it will only set breakpoints for the tasks in the current context. Tasks outside the current context are not affected.
- redirection from **dbx** subcommands is not supported.
- you cannot use the subcommands **clear**, **detach**, **edit**, **multproc**, **prompt**, **run**, **rerun**, **screen**, and the **sh** subcommand with no arguments.
- since **pdbx** runs in the Parallel Operating Environment, output from the parallel tasks may not be ordered. You can force task ordering, however, by setting the output mode to *ordered* using the **MP_STDOUTMODE** environment variable or the **-stdoutmode** flag when invoking your program with **pdbx**.

When a task hangs (there is no **pdbx** prompt) you can press **<Ctrl-c>** to acquire control. This displays the **pdbx** subset prompt `pdbx-subset([group | task])`, and provides a subset of **pdbx** functionality:
- Changing the current context
- Displaying information about groups/tasks
- Interrupting the application
- Showing breakpoint/tracepoint status
- Getting help
- Exiting the debugger.

You can change the subset of tasks to which context sensitive commands are directed. Also, you can understand more about the current state of the application, and gain control of your application at any time, not just at user-defined breakpoints.

At the **pdbx** subset prompt, all input you type at the command line is intercepted by **pdbx**. All commands are interpreted and operated on by the home node. No data is passed to the remote nodes and STDIN is not given to the application. Most commands at the **pdbx** subset prompt produce information about the application and then produce another **pdbx** subset prompt. The exceptions are the **halt**, **back**, **on**, and **quit** commands. For more information, see "Context switch when blocked" on page 16.

ENVIRONMENT VARIABLES

Because the **pdbx** command runs in the Parallel Operating Environment, it interacts with the same environment variables associated with the **poe** command. See the **poe** manual page in *IBM Parallel Environment for AIX: Operation and Use,* *Volume 1, Using the Parallel Operating Environment* for a description of these environment variables. As indicated by the syntax statements, you are also able to specify **poe** command line options when invoking **pdbx**. Using these options will override the setting of the corresponding environment variable, as is the case when invoking a parallel program with the **poe** command. Additional variables are:

HOME
: During **pdbx** initialization, **pdbx** uses this environment variable to search for two special initialization files. First, **pdbx** searches for *.pdbxinit* in the user's current directory. If the file is not found, **pdbx** checks the file *$HOME/.pdbxinit*.

SHELL
: The **sh** subcommand in **dbx**, which is available through **pdbx**, uses this environment variable to determine which shell to use. If this environment variable is not set, the default is the **sh** shell.

MP_DBXPROMPTMOD
: The **dbx** prompt *\n(dbx)* is used by **pdbx** as an indicator denoting that a **dbx** subcommand has completed. This environment variable can be used to modify the prompt. Any value assigned to **MP_DBXPROMPTMOD** will have a "." prepended and then be inserted in the *\n(dbx)* prompt between the "x" and the ")". This environment variable is needed in rare situations when the string *\n(dbx)* is present in the output of the application being debugged. For example, if **MP_DBXPROMPTMOD** is set to *unique157*, the prompt would be *\n(dbx.unique157)*.

MP_DEBUG_INITIAL_STOP
: This environment variable redefines the initial stop point in **pdbx** (overriding the stop in main). It can be set to *sourcefile:linenumber*, where *sourcefile* is a file containing source code of the program to be executed. Typically, the source file name ends with the **.c**, **.C**, or **f** suffix. *Linenumber* is a line number in this file. This line must contain executable code, not data declarations or Fortran FORMAT statements. It cannot be a comment, blank, or continuation line.

  If no *linenumber* is specified (and the colon is omitted), the *sourcefile* field is taken to be a function or subroutine name, and a "stop in" is performed on entry to the function.

  If **MP_DEBUG_INITIAL_STOP** is undefined, the default stop location will be the first executable line in the function main. For Fortran source programs, it will be the first executable line in the main program.

EXAMPLES

To start **pdbx**, first set up the execution environment as you would for the **poe** command, and then enter:

```
pdbx
```

After initialization, you should see the prompt:

```
pdbx(all)
```

FILES

.pdbxinit (Initial commands for **pdbx** in ./ or *$HOME*)

.pdbxinit.*process_id.task_id* (Initial commands for the individual **dbx** tasks)

For more information on .pdbxinit see Table 5 on page 5 and “Reading subcommands from a command file” on page 29.

Note: The following temporary files are created during the execution of **pdbx** in attach mode:

- */tmp/.pdbx.<poe-pid>.host.list* - a temporary host list file containing information needed to attach to tasks on remote nodes.
- */tmp/.pdbx.<pdbx-pid>.menu* - a temporary file to hold the attach task menu. Both of these files are removed before the debugger exits.

RELATED INFORMATION

Commands: **dbx**(1), **mpcc_r**(1), **mpCC_r**(1), **mpxlf_r**(1), **poe**(1)

Subcommands of the pdbx command

alias subcommand (of the pdbx command)

alias [*alias_name* [*alias_string*]]

The **alias** subcommand creates aliases for **pdbx** subcommands. The *alias_name* parameter is the alias being created. The *alias_string* is the **pdbx** subcommand for which you wish you define an alias, and is a single **pdbx** subcommand. If used without parameters, the **alias** subcommand displays all current aliases. If only *alias_name* is specified, it lists the alias name and the alias string that is assigned to it. This subcommand is context insensitive.

A number of default aliases are provided by **pdbx**. They are:

t	where
j	status
st	stop
s	step
x	registers
q	quit
p	print
n	next
m	map
l	list
h	help
d	delete
c	cont
th	thread
mu	mutex
cv	condition
attr	attribute

Apart from these, aliases are only known during the current **pdbx** session. They are not saved between **pdbx** sessions, and are lost upon exiting **pdbx**.

Note: One method for reusing aliases is to define them in *.pdbxinit* to allow them to be created for each **pdbx** execution. The default aliases are available after the partition has been loaded.

Aliases can also be removed using the **unalias** subcommand for the **pdbx** command.

1. If you have two task groups defined in your **pdbx** session called "master" and "workers", and you wish to define aliases to easily qualify each, enter:
   ```
   alias mas on master
   alias w on workers
   ```
   This will allow you to switch the command context between the master and workers groups by typing:
   ```
   mas
   ```
   to switch context to the "master" group, or:
   ```
   w
   ```
   to switch context to the "workers" group.
2. To display the string that has been defined for the alias "p", enter:
   ```
   alias p
   ```

3. To list all aliases currently defined, enter:
```
alias
```

Related to this subcommand is the **pdbx unalias** subcommand.

assign subcommand (of the pdbx command)

assign *<variable>* = *<expression>*

The **assign** subcommand assigns the value of an expression to a variable.

1. To assign a value of 5 to the x variable:
```
pdbx(all) assign x = 5
```
2. To assign the value of the y variable to the x variable:
```
pdbx(all) assign x = y
```
3. To assign the character value 'z' to the z variable:
```
pdbx(all) assign z = 'z'
```
4. To assign the boolean value false to the logical type variable B:
```
pdbx(all) assign B = false
```
5. To assign the "Hello World" string to a character pointer Y:
```
pdbx(all) assign Y = "Hello World"
```
6. To disable type checking, activate the set variable $unsafeassign:
```
pdbx(all) set $unsafeassign
```

attach subcommand (of the pdbx command)

attach all
attach *<task_list>*

The **attach** subcommand is used to attach the debugger to some or all the tasks of a given **poe** job.

Individual tasks are separated by spaces. A range of tasks may be separated by a dash or a colon. For example, the command **attach 2 4 5-7** would mean to attach to tasks 2,4,5,6, and 7.

attribute subcommand (of the pdbx command)

attribute
attribute [*<attribute_number>* ...]

The **attribute** subcommand displays information about the user thread, mutex, or condition attributes objects defined by the *attribute_number* parameters. If no parameters are specified, all attributes objects are listed.

For each attributes object listed, the following information is displayed:

attr
Indicates the symbolic name of the attributes object, in the form $a*attribute_number*.

obj_addr
Indicates the address of the attributes object.

type
Indicates the type of the attributes object; this can be **thr**, **mutex**, or **cond** for user threads, mutexes, and condition variables respectively.

state Indicates the state of the attributes object. This can be valid or invalid.

stack Indicates the stacksize attribute of a thread attributes object.

scope Indicates the scope attribute of a thread attributes object. This determines the contention scope of the thread, and defines the set of threads with which it must contend for processing resources. The value can be sys or pro for system or process contention scope.

prio Indicates the priority attribute of a thread attributes object.

sched Indicates the **schedpolicy** attribute of a thread attributes object. This attribute controls scheduling policy, and can be fifo (first in first out), rr (round robin), or other.

p-shar
Indicates the process-shared attribute of a mutex or condition attribute object. A mutex or condition is process-shared if it can be accessed by threads belonging to different processes. The value can be yes or no.

protocol
Indicates the protocol attribute of a mutex. This attribute determines the effect of holding the mutex on a thread's priority. The value can be no_prio, prio, or protect.

Related to this subcommand are the **condition mutex** and **thread** subcommands.

back subcommand (of the pdbx command)

back

The **back** command returns you to a **pdbx** prompt when you were already at a **pdbx** subset prompt. You can use the command if you want the application to continue as it was before **<Ctrl-c>** was issued. Also, you can use it at the **pdbx** subset prompt if all of the nodes are checked into "debug ready" state, and you want to do full **pdbx** processing.

The **back** command is only valid at the **pdbx** subset prompt.

call subcommand (of the pdbx command)

call *<procedure>* (*<parameters>*)

The **call** subcommand runs a procedure specified by the procedure parameter. The return code is not printed. If any parameters are specified, they are passed to the procedure being run.

The program stack will be returned to its previous state after the procedure specified by **call** completes. Any side effect of the procedure, such as global variable updates, will remain.

Related to this subcommand is the **print** subcommand.

case subcommand (of the pdbx command)

case [**default** | **mixed** | **lower** | **upper**]

The **case** subcommand changes how **pdbx** interprets symbols. The default handling of symbols is based on the current language. If the current language is C, C++, or undefined, the symbols are not folded. If the current language is Fortran, the symbols are folded to lowercase. Use this command if a symbol needs to be interpreted in a way not consistent with the current language.

Entering the **case** subcommand with no parameters displays the current case mode. The parameters include:

default
: Varies with the current language.

mixed
: Causes symbols to be interpreted as they actually appear.

lower
: Causes symbols to be interpreted as lowercase.

upper
: Causes symbols to be interpreted as uppercase.

catch subcommand (of the pdbx command)

catch
catch <*signal_number*>
catch <*signal_name*>

The **catch** subcommand with no arguments prints all signals currently being caught. If a signal is specified, **pdbx** will trap the signal before it is sent to the program. This is useful when the program being debugged has signal handlers.

When the program encounters a signal that is being caught to the debugger, a message stating which signal was detected is shown, and the **pdbx** prompt is displayed. To have the program continue and process the signal, issue the **cont** subcommand with the **signal** option. Other execution control commands and the **cont** subcommand without the **signal** option will cause the program to behave as if it had never encountered the signal.

A signal may be specified by number or name. Signal names are by default case insensitive and the “SIG” prefix is optional.

By default all signals are caught except SIGHUP, SIGKILL, SIGPIPE, SIGALRM, SIGCHLD, SIGIO and SIGVIRT. When debugging a threaded application (including those compiled with **mpcc_r**, **mpCC_r** or **mpxlf_r**), all signals are caught except SIGHUP, SIGKILL, SIGALRM, SIGCHLD, SIGIO and SIGVIRT.

Related to this subcommand are the **ignore** and **cont** subcommands.

condition subcommand (of the pdbx command)

condition
condition [<*condition_number*> ...]
condition [**wait** | **nowait**]

The **condition** subcommand displays the current state of all known conditions in the process. Condition variables to be listed can be specified through the

<*condition_number*> parameters, or all condition variables will be listed. Users can also choose to display only condition variables with or without waiters by using the **wait** or **nowait** options.

The information listed for each condition is as follows:

cv Indicates the symbolic name of the condition variable, in the form $c*condition_number*.

obj_addr
Indicates the memory address of the condition variable.

num_wait
Indicates the number of threads waiting on the condition variable.

waiters
Lists the user threads which are waiting on the condition variable.

Related to this subcommand are the **attribute mutex** and **thread** subcommands.

cont subcommand (of the pdbx command)

cont
cont <*signal_number*>
cont <*signal_name*>

The **cont** subcommand allows execution to continue from where the program last stopped, until either the program finishes or another breakpoint is reached. If a signal is specified, it is given to the program, and the process continues as though it received the signal. If a signal is not specified, the process continues as though it had not been stopped.

Related to this subcommand are the **catch**, **ignore**, **step**, **stepi**, **next**, and **nexti** subcommands.

dbx subcommand (of the pdbx command)

dbx *dbx_subcommand*

The **dbx** subcommand is context sensitive and will pass the specified *dbx_subcommand* directly to the **dbx** running on each task in the current context with no **pdbx** intervention. The specified *dbx_subcommand* can be any valid **dbx** subcommand.

Note: The **pdbx** command uses **dbx** to access tasks on individual nodes. In many cases, **pdbx** saves and requires its own state information about the tasks. Some **dbx** commands will circumvent the ability of **pdbx** to maintain accurate state information about the tasks being debugged. Therefore, use the **dbx** subcommand with caution. In general, **dbx** subcommands used to display information will have no adverse side effects. The subcommands **clear**, **detach**, **edit**, **multproc**, **prompt**, **run**, **rerun**, **screen**, and the **sh** subcommand with no arguments are currently unsupported under **pdbx** and should not be used.

To display the events that the **dbx** running as task 1 recognizes, enter:

```
on 1 dbx status
```

Related to this subcommand is the **dbx** command.

delete subcommand (of the pdbx command)

delete [*event_list*] | [*] | [**all**]

The **delete** subcommand removes events (breakpoints and tracepoints) of the specified event numbers. An event list can be specified in the following manner. To indicate a range of events, enter the first and last event numbers, separated by a colon or dash. To indicate individual events, enter the numbers, separated by a space or comma. You can specify " * ", which deletes all events that were created in the current context. You can also specify "all", which deletes all events, regardless of context.

The event number is the one associated with the breakpoint or tracepoint. This number is displayed by the **stop** and **trace** subcommands when an event is built. Event numbers can also be displayed using the **status** subcommand.

The output of the status command shows the context from which the event was created. Event numbers are unique to the context in which they were set. Keep in mind that, in order to remove an event, the context must be on the appropriate task or task group.

Assume the command context is set on task 1 and the output of the **status** subcommand is:

```
1:[0] stop in celsius
all:[0] stop at "foo.c":19
all:[1] trace "foo.c":21
```

To delete all these events, you would do one of the following:

```
on 1
delete 0
on all
delete 0,1

OR

on 1
delete 0
on all
delete *

OR

delete all
```

Related to this subcommand are the **pdbx status**, **stop**, and **trace** subcommands.

detach subcommand (of the pdbx command)

detach

The **detach** subcommand detaches **pdbx** from all tasks that were attached. This subcommand causes the debugger to exit but leaves the **poe** application running.

dhelp subcommand (of the pdbx command)

dhelp
dhelp *<dbx_command>*

The **dhelp** command with no arguments displays a list of **dbx** commands about which detailed information is available.

If you type **dhelp** with an argument, information will be displayed about that command.

Note: The partition must be loaded before you can use this command, because it invokes the **dbx help** command. It is also required that a task be in “debug ready” state to process this command.

Related to this subcommand is the **pdbx help** subcommand.

display memory subcommand (of the pdbx command)

<address> / [*<mode>*]
<address> , *<address>* / [*<mode>*]
<address> / [*<count>*] [*<mode>*]

The **display memory** subcommand, which does not have a keyword to initiate the command, displays a portion of memory controlled by the address(es), count(s) and mode(s) specified.

If an address is specified, the display contents of memory at that address is printed. If more than one address or count locations are specified, display contents of memory starting at the first *<address>* up to the second *<address>* or until *<count>* items are printed. If the address is “.”, the address following the one most recently printed is used. The mode specifies how memory is to be printed. If it is omitted the previous mode specified is used. The initial mode is “X”.

The following modes are supported:

i print the machine instruction

d print a short word in decimal

D print a long word in decimal

o print a short word in octal

O print a long word in octal

x print a short word in hexadecimal

X print a long word in hexadecimal

b print a byte in octal

c print a byte as a character

h print a byte in hexadecimal

s print a string (terminated by a null byte)

f print a single precision real number

g print a double precision real number

q print a quad precision real number

lld print an 8 byte signed decimal number

llu print an 8 byte unsigned decimal number

llx print an 8 byte unsigned hexadecimal number

llo print an 8 byte unsigned octal number

down subcommand (of the pdbx command)

down [*count*]

The **down** subcommand moves the current function down the stack the number of levels specified by *count*. The current function is used for resolving names. The default for the *count* parameter is one.

The **up** and **down** subcommands can be used to navigate through the call stack. Using these subcommands to change the current function also causes the current file and local variables to be updated to the chosen stack level.

Related to this subcommand are the **up**, **print**, **dump**, **func**, **file**, and **where** commands.

dump subcommand (of the pdbx command)

dump
dump <*procedure*>
dump .
dump <*module name*>

The **dump** subcommand prints the names and values of variables in a given procedure, or the current one if nothing is specified. If the procedure given is ".", then all active variables are printed. If a module name is given, all variables in the module are printed.

Related to this subcommand are the **up**, **down**, **print**, and **where** subcommands.

file subcommand (of the pdbx command)

file [*file*]

The **file** subcommand changes the current source file to the file specified by the *file* parameter. It does not write to that file. The *file* parameter can specify a full path name to the file. If the parameter does not specify a path, the **pdbx** program tries to find the file by searching the use path. If the parameter is not specified, the **file** subcommand displays the name of the current source file. The **file** subcommand also displays the full or relative path name of the file if the path is known.

Related to this subcommand is the **func** subcommand.

func subcommand (of the pdbx command)

func [*procedure*]

The **func** command changes the current function to the procedure or function specified by the *procedure* parameter. If the *procedure* parameter is not specified, the default current function is displayed. Changing the current function implicitly changes the current source file to the file containing the new function. The current scope used for name resolution is also changed.

Related to this subcommand is the **file** subcommand.

goto subcommand (of the pdbx command)

goto *<line_number>*
goto "*<filename>*" : *<line_number>*

The **goto** subcommand causes the specified source line to be run next. Normally, the source line must be in the same function as the current source line. To override this restriction, use the **set** subcommand with the **$unsafegoto** flag.

gotoi subcommand (of the pdbx command)

gotoi *address*

The **gotoi** subcommand changes the program counter address to the address specified by the *address* parameter.

group subcommand (of the pdbx command)

group add *group_name task_list*
group delete *group_name* [task_list]
group change *old_group_name new_group_name*
group list [*group_name*]

The **group** subcommand groups individual tasks under a common name for easier setting of command context. It can add or delete a group, add or delete tasks from a group, change the name of a group, list the tasks in a group, or list all groups. This subcommand is context insensitive.

Provide a group name that is no longer than 32 characters which starts with an alphabetic character, and is followed by any alphanumeric character combination.

To indicate a range of tasks, enter the first and last task numbers, separated by a colon or dash. To indicate individual tasks, enter the numbers, separated by a space or comma. Individual task identifiers and ranges can also be combined in creating the desired *task_list*.

Note: Group names "all", "none", and "attached" are reserved group names. They are used by the debugger and cannot be used in the **group add** or **group delete** commands. However, the group "all" or "attached" can be renamed using the **group change** command, if it currently exists in the debugging session.

The **add** action adds one or more tasks to a new or existing task group. The *task_list* specified is a list of task identifiers to be included in the new or existing group.

The **delete** action deletes an existing task group, or deletes one or more tasks from an existing task group. The *task_list*, if specified, is a list of task identifiers to be deleted from the new or existing group.

The **change** action changes the name of a task group from *old_group_name* to *new_group_name*.

The **list** action displays the task members for the *group_name* specified, or for all task groups. The task identifiers will be followed by a one-letter status indicator.

N	Not loaded	the remote task has not yet been loaded with an executable.
S	Starting	the remote task is being loaded with an executable.
D	Debug ready	the remote task is stopped and debug commands can be issued.
R	Running	the remote task is in control and executing the program.
X	Exited	the remote task has completed execution.
U	Unhooked	the remote task is executing without debugger intervention.
E	Error	the remote task is in an unknown state.

Consider an application running as five tasks numbered 0 through 4.

1. To create a task group "first" containing task 0, enter:
   ```
   group add first 0
   ```
   The **pdbx** debugger responds with:
   ```
   1 task was added to group "first".
   ```
2. To create a task group "rest" containing tasks 1 through 4, enter:
   ```
   group add rest 1:4
   ```
   The **pdbx** debugger responds with:
   ```
   4 tasks were added to group "rest".
   ```
3. To change the name of the default group "all" to "johnny", enter:
   ```
   group change all johnny
   ```
   The **pdbx** debugger responds with:
   ```
   Group "all" has been renamed to "johnny"
   ```
4. To list all of the groups and the tasks they contain, enter:
   ```
   group list
   ```
   The **pdbx** debugger responds with:
   ```
   johnny    0:D    1:D    2:D    3:D    4:D
   first     0:D
   rest      1:D    2:D    3:D    4:D
   ```
5. To delete the group "first", enter:
   ```
   group delete first
   ```
   To delete members 1, 2 and 3 from group "rest", enter:
   ```
   group delete rest 1 2 3
   ```
   or
   ```
   group delete rest 1-3
   ```
   The **pdbx** debugger responds with:
   ```
   Task: 1 was successfully deleted from group "rest".
   Task: 2 was successfully deleted from group "rest".
   Task: 3 was successfully deleted from group "rest".
   ```

6. To list all of the groups and the tasks they contain, enter:

```
group list
```

The **pdbx** debugger responds with:

```
allTasks      0:R     1:D     2:D     3:U     4:U     5:D     6:D
              7:D     8:D     9:D    10:D    11:D
evenTasks     0:R     2:D     4:U     6:D     8:D    10:R
oddTasks      1:D     3:U     5:D     7:D     9:D    11:R
master        0:R
workers       1:D     2:D     3:U     4:U     5:D     6:D     7:D
              8:D     9:D    10:R    11:R
```

Related to this subcommand is the **pdbx on** subcommand.

halt subcommand (of the pdbx command)

halt [**all**]

By using the **halt** command, you interrupt all tasks in the current context that are running. This allows the debugger to gain control of the application at whatever point the running tasks happen to be in the application. To a **dbx** user, this is the same as using **<Ctrl-c>**. This command works at the **pdbx** prompt and **pdbx** subset prompt. If you specify "all" with the command, all running tasks, regardless of context, are interrupted.

Note: At a **pdbx** prompt, the **halt** command never has any effect without "all" specified. This is because by definition, at a **pdbx** prompt, none of the tasks in the current context are in "running" state.

The **halt all** command at the **pdbx** prompt affects tasks outside of the current context. Messages at the prompt show the task numbers that are and are not interrupted, but the **pdbx** prompt returns immediately because the state of the tasks in the current context is unchanged.

When using **halt** at the **pdbx** subset prompt, the **pdbx** prompt occurs when all tasks in the current context have returned to "debug ready" state. If some of the tasks in the current context are running, a message is presented.

Related to this subcommand are the **pdbx tasks** and **group list** subcommands.

help subcommand (of the pdbx command)

help - display subjects
help <*subject*> - display details

The **help** command with no arguments displays a list of **pdbx** commands and topics about which detailed information is available.

If you type **help** with one of the **help** commands or topics as the argument, information will be displayed about that subject.

Related to this subcommand is the **pdbx dhelp** subcommand

hook subcommand (of the pdbx command)

hook

The **hook** subcommand allows you to reestablish control over all tasks in the current command context that have been unhooked using the **unhook** subcommand. This subcommand is context sensitive.

1. To reestablish control over task 2 if it has been unhooked, enter:

   ```
   on 2 hook
   ```

   or

   ```
   on 2
   hook
   ```

2. To reestablish control over all unhooked tasks in the task group “rest”, enter:

   ```
   on rest hook
   ```

   or

   ```
   on rest
   hook
   ```

Listing the members of the task group “all” using the **list** action of the **group** subcommand will allow you to check which tasks are hooked and which are unhooked. Enter:

```
group list all
```

The **pdbx** debugger will display a list similar to the following:

```
0:D    1:U    2:D    3:D
```

Tasks marked with the letter D next to them are debug ready, hooked tasks. In this case, tasks 0, 2, and 3 are debug ready. Tasks marked with the letter U are unhooked. In this case, task 1 is unhooked.

Related to this subcommand are the **dbx detach** subcommand and the **pdbx unhook** subcommand.

ignore subcommand (of the pdbx command)

ignore
ignore <*signal_number*>
ignore <*signal_name*>

The **ignore** subcommand with no arguments prints all signals currently being ignored. If a signal is specified, **pdbx** stops trapping the signal before it is sent to the program.

A signal may be specified by number or name. Signal names are by default case insensitive and the “SIG” prefix is optional.

All signals except SIGHUP, SIGKILL, SIGPIPE, SIGALRM, SIGCHLD, SIGIO, and SIGVIRT are trapped by default. When debugging a threaded application (including those compiled with **mpcc_r**, **mpCC_r**, or **mpxlf_r**), all signals except SIGHUP, SIGKILL, SIGALRM, SIGCHLD, SIGIO, and SIGVIRT are trapped by default.

The **pdbx** debugger cannot ignore the SIGTRAP signal if it comes from a process outside of the program being debugged.

Related to this subcommand is the **catch** subcommand.

list subcommand (of the pdbx command)

list [*procedure* | *sourceline-expression*[, *sourceline-expression*]]

The **list** subcommand displays a specified number of lines of the source file. The number of lines displayed is specified in one of two ways:

Tip: Use **on** <*task*> **list**, or specify the ordered standard output option.

- By specifying a procedure using the *procedure* parameter.

  In this case, the **list** subcommand displays lines starting a few lines before the beginning of the specified procedure and until the list window is filled.
- By specifying a starting and ending source line number using the *sourceline-expression* parameter.

  The *sourceline-expression* parameter should consist of a valid line number followed by an optional + (plus sign), or − (minus sign), and an integer. In addition, a *sourceline* of $ (dollar sign) can be used to denote the current line number. A *sourceline* of @ (at sign) can be used to denote the next line number to be listed.

  All lines from the first line number specified to the second line number specified, inclusive, are then displayed, provided these lines fit in the list window.

  If the second source line is omitted, 10 lines are printed, beginning with the line number specified in the *sourceline* parameter.

  If the **list** subcommand is used without parameters, the default number of lines is printed, beginning with the current source line. The default is 10.

  To change the number of lines to list by default, set the special debug program variable, *$listwindow*, to the number of lines you want. Initially, *$listwindow* is set to 10.

To list the lines 1 through 10 in the current file, enter:

```
list 1,10
```

To list 10, or *$listwindow*, lines around the main procedure, enter:

```
list main
```

To list 11 lines around the current line, enter:

```
list $-5,$+5
```

To list the next source line to be executed, issue:

```
pdbx(all) list $
  0:    4       char johnny = 'h';
  1:    4       char johnny = 'h';
```

To just show 1 task, since both are at the same source line:

```
pdbx(all) on 0 list $
  0:    4       char johnny = 'h';
```

To create an alias to list just task 0:

```
pdbx(all) alias l0 on 0 list
```

To list line 5:

```
pdbx(all) l0 5
  0:    5       char jessie  = 'd';
```

To list lines around the procedure sub:

```
pdbx(all) l0 sub
  0:   21
  0:   22   /* return ptr to sum of parms, calc and sub1 */
  0:   23   int *sub(char *s, int a, int k)
  0:   24   {
  0:   25       int *tmp;
  0:   26       int it = 0;
  0:   27       int i, j;
  0:   28
  0:   29       /* test calc */
  0:   30       i = 1;
  0:   31       j = i*2;
```

To change the next line to be listed to line 25:

```
pdbx(all) move 25
```

To list the next line to be listed minus two:

```
pdbx(all) l0 @-2
  0:   23   int *sub(char *s, int a, int k)
```

Related to this subcommand is the **dbx list** subcommand.

listi subcommand (of the pdbx command)

listi [*procedure* | **at** *SourceLine* |
address [,*address*]]

The **listi** subcommand displays a specified set of instructions from the current program counter, depending on whether you specify procedure, source line, or address.

The **listi** subcommand with the *procedure* parameter lists instructions from the beginning of the specified procedure until the **list** window is filled.

Using the **at** *SourceLine* flag with the **listi** subcommand displays instructions beginning at the specified source line and continuing until the **list** window is filled. The *SourceLine* variable can be specified as an integer, or as a file name string followed by a : (colon) and an integer.

Specifying a beginning and ending address with the **listi** subcommand, using the *address* parameters, displays all instructions between the two addresses.

If the **listi** subcommand is used without flags or parameters, the next **$listwindow** instructions are displayed. To change the current size of the **list** window, use the **set $listwindow**=*Value* command.

load subcommand (of the pdbx command)

load *program* [*program_options*]

The **load** subcommand loads the specified application *program* to be debugged on the task(s) in the current context. You can optionally specify *program_options* to be passed to the application program. **pdbx** will look for the program in the current directory unless a relative or absolute pathname is specified. The **load** subcommand is context sensitive. All tasks in the partition must have an application program loaded before other context sensitive subcommands can be issued. This subcommand enables you to individually or selectively load programs. If you wish to load the same program on all tasks in the partition, the name of the program can be passed as an argument to the **pdbx** command at startup.

To load the program "mpprob1" on all tasks in the current context, enter:

```
load mpprob1
```

map subcommand (of the pdbx command)

map

The **map** subcommand displays characteristics for each loaded portion of the application. This information includes the name, text origin, text length, data origin, and data length for each loaded module.

mutex subcommand (of the pdbx command)

mutex
mutex [<*number*> ...]
mutex [**lock** | **unlock**]

The **mutex** subcommand displays the current status of all known mutual exclusion locks in the process. Mutexes to be listed can be specified through the <*number*> parameter, or all mutexes will be listed. Users can also choose to display only locked or unlocked mutexes by using the **lock** or **unlock** options.

The information listed for each mutex is as follows:

mutex
Indicates the symbolic name of the mutex, in the form $m*mutex_number*.

type Indicates the type of the mutex: non-rec (nonrecursive), recursi (recursive) or fast.

obj_addr
Indicates the memory address of the mutex.

lock Indicates the lock state of the mutex: yes if the mutex is locked, no if not.

owner
If the mutex is locked, indicates the symbolic name of the user thread which holds the mutex.

Related to this subcommand are the **attribute condition** and **thread** subcommands.

next subcommand (of the pdbx command)

next [*number*]

The **next** subcommand runs the application program up to the next source line. The *number* parameter specifies the number of times the subcommand runs. If the *number* parameter is not specified, **next** runs once only.

The difference between this and the **step** subcommand is that if the line contains a call to a procedure or function, **step** will stop at the beginning of that block, while **next** will not.

If you use the **next** subcommand in a multi-threaded application program, all the user threads run during the operation, but the program continues execution until the running thread reaches the specified source line. By default, breakpoints for all threads are ignored during the **next** command. This behavior can be changed using the **$catchbp** set variable. If you wish to step the running thread only, use the **set** command to set the variable *$hold_next*. Setting this variable may result in deadlock, since the running thread may wait for a lock held by one of the blocked threads.

Related to this subcommand are the **nexti**, **step**, **stepi**, **return**, **cont**, and **set** subcommands.

nexti subcommand (of the pdbx command)

nexti [*number*]

The **nexti** subcommand runs the application program up to the next instruction. The *number* parameter specifies the number of times the subcommand will run. If the *number* parameter is not specified, **nexti** runs once only.

The difference between this and the **stepi** subcommand is that if the line contains a call to a procedure or function, **stepi** will stop at the beginning of that block, while **nexti** will not.

If you use the **nexti** subcommand in a multi-threaded application program, all the user threads run during the operation, but the program continues execution until the running thread reaches the specified machine instruction. If you wish to step the running thread only, use the **set** command to set the variable *$hold_next*. Setting this variable may result in deadlock since the running thread may wait for a lock held by one of the blocked threads.

Related to this subcommand are the **next**, **step**, **stepi**, **return**, **cont**, and **set** subcommands.

on subcommand (of the pdbx command)

on {*group_name* | *task_id*} [*subcommand*]

The **on** subcommand sets the current command context used to direct subsequent subcommands at a specific task or group of tasks. The context can be set on a task group (by specifying a *group_name*) or on a single task (by specifying a *task_id*).

When a context sensitive *subcommand* is specified, it is directed to the given context without changing the current command context. Thus, specifying the optional *subcommand* enables you to temporarily deviate from the command context.

Note: The **pdbx** prompt will be presented after all of the tasks in the temporary context have completed the specified command. It is possible using **<Ctrl-c>** followed by the **back** or the **on** command to issue further **pdbx** commands in the original context.

By using the **on** and **group** subcommands, the number of subcommands issued and the amount of debug data displayed can be tailored to manageable amounts.

When you switch context using **on** *context_name*, and the new context has at least one task in the *running* state, a message is displayed stating that at least one task is in the *running* state. Thus, no **pdbx** prompt is displayed until all tasks in this context are in the *debug ready* state.

When you switch to a context where all states are in the *debug ready* state, the **pdbx** prompt is displayed immediately.

At the **pdbx** subset prompt, **on** *context_name* causes one of the following to happen: either a **pdbx** prompt is displayed; or a message is displayed indicating the reason why the **pdbx** prompt will be displayed at a later time. This is generally because one of the tasks is in running state. See "Context switch when blocked" on page 16 for more information on the **pdbx** subset prompt.

At a **pdbx** prompt, you cannot use **on** *context_name pdbx_command* if any of the tasks in the specified context are running.

Assume you have an application running as 15 tasks, and the output of the **group list** subcommand lists the existing task groups as:

```
all        0:D    1:U    2:D    3:D    4:D    5:D    6:U    7:D
           8:D    9:D   10:R   11:R   12:R   13:U   14:U
johnny     0:D
jessica    2:D    3:D    8:D
un         1:U    6:U   13:U   14:U
run       10:R   11:R   12:R
deb        2:D    3:D    4:D    5:D    8:D    9:D
```

1. To add a breakpoint for task 0, enter:

   ```
   on johnny stop at 31
   ```

   The **pdbx** debugger responds with:

   ```
   johnny:[0] stop at "ring.f":31
   ```

2. To add breakpoints for all of the tasks in the task group "jessica", enter:

   ```
   on jessica stop in ring
   ```

   The **pdbx** debugger responds with:

   ```
   jessica:[0] stop in ring
   ```

3. To switch the current context to the task group "johnny", enter:

   ```
   on johnny
   ```

   The **pdbx** debugger responds with the prompt:

   ```
   pdbx(johnny)
   ```

4. To add a conditional breakpoint for all tasks in the current context, enter:

   ```
   stop at 48 if len < 1
   ```

   The **pdbx** debugger responds with:

   ```
   johnny:[1] stop at "ring.f":48 if len < 1
   ```

5. To view the events that have been set on the task group "jessica", enter:

   ```
   on jessica status
   ```

   The **pdbx** debugger responds with:

   ```
   jessica:[0] stop in ring
   ```

6. To add a tracepoint for task 2, enter:

   ```
   on 2
   ```

   The **pdbx** debugger responds with the prompt:

   ```
   pdbx(2)
   ```

   Then, enter:

   ```
   trace 57
   ```

The **pdbx** debugger responds with:

```
2:[0] trace "ring.f":57
```

7. To view all of the events that have been set, enter:

```
status all
```

The **pdbx** debugger responds with:

```
2:[0] trace "ring.f":57
johnny:[0] stop at "ring.f":48
johnny:[1] stop at "ring.f":56 if len < 1
jessica:[0] stop in ring
```

Related to this subcommand is the **pdbx group** subcommand.

print subcommand (of the pdbx command)

print *expression* ...
print *procedure* ([*parameters*])

The **print** subcommand does either of the following:

- Prints the value of a list of expressions, specified by the *expression* parameters.
- Executes a procedure, specified by the *procedure* parameter, and prints the return value of that procedure. Parameters that are included are passed to the procedure.

To display the value of `x` and the value of `y` shifted left two bits, enter:

```
print x, y << 2
```

To display the value returned by calling the **sbrk** routine with an argument of `0`, enter:

```
print sbrk(0)
```

To display the sixth through the eighth elements of the Fortran character string *a_string*, enter:

```
print &a_string + 5, &a_string + 7/c
```

Related to this subcommand are the **dbx assign** and **call** subcommands, and the **pdbx set** subcommand.

quit subcommand (of the pdbx command)

quit

The **quit** subcommand terminates all program tasks, and ends the **pdbx** debugging session. The **quit** subcommand is context insensitive and has no parameters.

Quitting a debug session in attach mode causes the debugger and all the members of the original **poe** application partition to exit.

To exit the **pdbx** debug program, enter:

```
quit
```

registers subcommand (of the pdbx command)

registers

The **registers** subcommand displays the values of general purpose registers, system control registers, floating-point registers, and the current instruction register.

Registers can be displayed or assigned to individually by using the following predefined register names:

$r0 through $r31
for the general purpose registers.

$fr0 through $fr31
for the floating point registers.

$sp, $iar, $cr, $link
for, respectively, the stack pointer, program counter, condition register, and link register.

By default, the floating-point registers are not displayed. To display the floating-point registers, use the **unset** *$noflregs* command.

Notes:

1. The register value may be set to the 0xdeadbeef hexadecimal value. The 0xdeadbeef hexadecimal value is an initialization value assigned to general purpose registers at process initialization.
2. The **registers** command cannot display registers if the current thread is in kernel mode.

return subcommand (of the pdbx command)

return [*procedure*]

The **return** subcommand causes the program to execute until a return to the procedure, specified by the *procedure* parameter, is reached. If the *procedure* parameter is not specified, execution ceases when the current procedure returns.

search subcommand (of the pdbx command)

/<*regular_expression*>[**/**]
?<*regular_expression*>[**?**]

The search forward (**/**) or search backward (**?**) subcommands allow you to search in the current source file for the given <*regular_expression*>. Both forms of search wrap around. The previous regular expression is used if no regular expression is given to the current command.

Related to this subcommand is the **regcmp** subroutine.

set subcommand (of the pdbx command)

set [*variable*]
set [*variable=expression*]

The **set** subcommand defines a value for the set variable. The value is specified by the *expression* parameter. The set variable is specified by the *variable* parameter. The name of the variable should not conflict with names in the program being debugged. A variable is expanded to the corresponding expression within other commands. If the **set** subcommand is used without arguments, the currently set variables are displayed.

Related to this subcommand is the **unset** subcommand.

sh subcommand (of the pdbx command)

sh <*command*>

The **sh** subcommand passes the command specified by the *command* parameter to the shell on the remote task(s) for execution. The **SHELL** environment variable determines which shell is used. The default is the Bourne shell (sh).

Note: The **sh** subcommand with no arguments is not supported.

To run the **ls** command on all tasks in the current context, enter:

```
sh ls
```

To display contents of the *foo.dat* data file on task 1, enter:

```
on 1 cat foo.dat
```

skip subcommand (of the pdbx command)

skip [*number*]

The **skip** subcommand continues execution of the program from the current stopping point, ignoring the next breakpoint. If a *number* variable is supplied, **skip** ignores that next amount of breakpoints.

Related to this subcommand is the **cont** subcommand.

source subcommand (of the pdbx command)

source *commands_file*

The **source** subcommand reads **pdbx** subcommands from the specified *commands_file*. The *commands_file* should reside on the node where **pdbx** was issued and can contain any commands that are valid on the **pdbx** command line. The **source** subcommand is context insensitive.

To read **pdbx** subcommands from a file named “jessica”, enter:

```
source jessica
```

Related to this subcommand is the **dbx source** subcommand.

status subcommand (of the pdbx command)

status
status all

A list of **pdbx** events (breakpoints and tracepoints) can be displayed by using the **status** subcommand. You can specify “all” after this command to list all events (breakpoints and tracepoints) that have been set in all groups and tasks. This is valid at the **pdbx** prompt and the **pdbx** subset prompt.

Because the **status** command without "all" specified is context sensitive, it will not display status for events outside the context.

Assume the following commands have been issued, setting various breakpoints and tracepoints.

```
on all
stop at 19
trace 21
on 0
trace foo at 21
on 1
stop in func
```

To display a list of breakpoints and tracepoints for tasks in the current "task 1" context, enter:

```
status
```

The **pdbx** debugger responds with lines of status like:

```
1:[0] stop in func
all:[0] stop at "foo.c":19
all:[1] trace "foo.c":21
```

Notice that the status from the "task 0" context does not get displayed since the context is on "task 1". Also notice that event 0 is unique for the "task 1" context and the "group all" context.

To see an example of **status all**, enter:

```
status all
```

The **pdbx** debugger responds with:

```
0:[0] trace foo at "foo.c":21
1:[0] stop in func
all:[0] stop at "foo.c":19
all:[1] trace "foo.c":21
```

Related to this subcommand are the **pdbx stop**, **trace**, and **delete** subcommands.

step subcommand (of the pdbx command)

step [*number*]

The **step** subcommand runs source lines of the program. You specify the number of lines to be executed with the *number* parameter. If this parameter is omitted, the default is a value of 1.

The difference between this and the **next** subcommand is that if the line contains a call to a procedure or function, **step** will enter that procedure or function, while **next** will not.

If you use the **step** subcommand on a multi-threaded program, all the user threads run during the operation, but the program continues execution until the interrupted thread reaches the specified source line. By default, breakpoints for all threads are ignored during the **step** command. This behavior can be changed using the **$catchbp** set variable.

If you wish to step the interrupted thread only, use the **set** subcommand to set the variable *$hold_next*. Setting this variable may result in debugger induced deadlock, since the interrupted thread may wait for a lock held by one of the threads blocked by *$hold_next*.

Note: Use the *$stepignore* variable of the **set** subcommand to control the behavior of the **step** subcommand. The *$stepignore* variable enables **step** to step over large routines for which no debugging information is available.

Related to this subcommand are the **stepi**, **next**, **nexti**, **return**, **cont**, and **set** commands.

stepi subcommand (of the pdbx command)

stepi [*Number*]

The **stepi** subcommand runs instructions of the program. You specify the number of instructions to be executed with the *number* parameter. If the parameter is omitted, the default is 1.

If used on a multi-threaded program, the **stepi** subcommand steps the interrupted thread only. All other user threads remain stopped.

Related to this subcommand are the **step**, **next**, **nexti**, **return**, **cont**, and **set** subcommands.

stop subcommand (of the pdbx command)

stop **if** <*condition*>
stop **at** <*source_line_number*> [**if** <condition>]
stop **in** <*procedure*> [**if** <condition>]
stop <*variable*> [**if** <condition>]
stop <*variable*> **at** <*source_line_number*>
[**if** <condition>]
stop <*variable*> **in** <*procedure*> [**if** <condition>]

Specifying **stop at** <*source_line_number*> causes the breakpoint to be triggered each time that source line is reached.

Specifying **stop in** <*procedure*> causes the breakpoint to be triggered each time the program counter reaches the first executable source line in the procedure (function, subroutine).

Using the <*variable*> argument to stop causes the breakpoint to be triggered when the contents of the variable changes. This form of breakpoint can be very time consuming. For better results, when possible, further qualify these breakpoints with a *source_line* or *procedure* argument.

Specify the <*condition*> argument using the syntax described by "Specifying expressions" on page 30.

The **stop** subcommand sets stopping places called "breakpoints" for tasks in the current context. Use it to mark these stopping places, and then run the program. When the tasks reach a breakpoint, execution stops and the state of the program can then be examined. The **stop** subcommand is context sensitive.

Use the **status** subcommand to display a list of breakpoints that have been set for tasks in the current context. Use the **delete** subcommand to remove breakpoints.

Specifying **stop at** <*source_line_number*> causes the breakpoint to be triggered each time that source line is reached.

Specifying **stop in** <*procedure*> causes the breakpoint to be triggered each time the program counter reaches the first executable source line in the procedure (function, subroutine).

Using the <*variable*> argument to stop causes the breakpoint to be triggered when the contents of the variable changes. This form of breakpoint can be very time consuming. For better results, when possible, further qualify these breakpoints with a *source_line* or *procedure* argument.

Specify the <*condition*> argument using the syntax described by "Specifying expressions" on page 30.

Notes:

1. The **pdbx** debugger will not attempt to set a breakpoint at a line number when in a group context if the group members (tasks) have different current source files.
2. When specifying variable names as arguments to the **stop** subcommand, fully qualified names should be used. This should be done because, when a **stop** subcommand is issued, a parallel application could be in a different function on each node. This may result in ambiguity in variable name resolution. Use the **which** subcommand to get the fully qualified name for a variable.

To set a breakpoint at line 19 of a program, enter:

```
stop at 19
```

The **pdbx** debugger responds with a message like:

```
all:[0] stop at "foo.c":19
```

Related to this subcommand are the **dbx stop** and **which** subcommands, and the **pdbx trace**, **status**, and **delete** subcommands.

tasks subcommand (of the pdbx command)

tasks [long]

With the **tasks** subcommand, you display information about all the tasks in the partition. Task state information is always displayed. If you specify "long" after the command, it also displays the name, ip address, and job manager number associated with the task.

Following is an example of output produced by the **tasks** and **tasks long** command.

```
pdbx(others) tasks
  0:D     1:D     2:U     3:U     4:R     5:D     6:D     7:R

pdbx(others) tasks long
  0:Debug ready   pe04.kgn.ibm.com                9.117.8.68       -1
  1:Debug ready   pe03.kgn.ibm.com                9.117.8.39       -1
  2:Unhooked      pe02.kgn.ibm.com                9.117.11.56      -1
  3:Unhooked      augustus.kgn.ibm.com            9.117.7.77       -1
  4:Running       pe04.kgn.ibm.com                9.117.8.68       -1
```

```
5:Debug ready   pe03.kgn.ibm.com                9.117.8.39      -1
6:Debug ready   pe02.kgn.ibm.com                9.117.11.56     -1
7:Running       augustus.kgn.ibm.com            9.117.7.77      -1
```

Related to this subcommand is the **pdbx group** subcommand.

thread subcommand (of the pdbx command)

thread
thread [<*number*>...]
thread [**info**] [<*number*> ...]
thread [**run** | **wait** | **susp** | **term**]
thread [**hold** | **unhold**] [<*number*> ...]
thread [**current**] [<*number*>]

The **thread** subcommand displays the current status of all known threads in the process. Threads to be displayed can be specified through the <*number*> parameters, or all threads will be listed. Threads can also be selected by states using the **run**, **wait**, **susp**, **term, or current** options. The **info** option can be used to display full information about a thread. The **hold** and **unhold** options affect whether the thread is dispatchable when further execution control commands are issued. A thread that has been held will not be given any execution time until the unhold option is issued. The **thread** subcommand displays a column indicating whether a thread is held or not. No further execution will occur if the interrupted thread is held.

The information displayed by the **thread** subcommand is as follows:

thread
: Indicates the symbolic name of the user thread, in the form $t*thread_number*.

state-k
: Indicates the state of the kernel thread (if the user thread is attached to a kernel thread). This can be run, wait, susp, or term, for running, waiting, suspended, or terminated.

wchan
: Indicates the event on which the kernel thread is waiting or sleeping (if the user thread is attached to a kernel thread).

state-u
: Indicates the state of the user thread. Possible states are running, blocked, or terminated.

k-tid
: Indicates the kernel thread identifier (if the user thread is attached to a kernel thread).

mode
: Indicates the mode (kernel or user) in which the user thread is stopped (if the user thread is attached to a kernel thread).

held
: Indicates whether the user thread has been held.

scope
: Indicates the contention scope of the user thread; this can be sys or pro for system or process contention scope.

function
: Indicates the name of the user thread function.

The displayed thread (“>”) is the thread that is used by other **pdbx** commands that are thread specific such as:

down
dump
file
func
list
listi
print
registers
up
where

The displayed thread defaults to be the interrupted thread after each execution control command. The displayed thread can be changed using the current option.

The interrupted thread ("*") is the thread that stopped first and because it stopped, in turn caused all of the other threads to stop. The interrupted thread is treated specially by subsequent **step**, **next**, and **nexti** commands. For these stepping commands, the interrupted thread is stepped, while all other (unheld) threads are allowed to continue.

To force only the interrupted thread to execute during execution control commands, set the *$hold_next* set variable. Note that this can create a debugger induced deadlock if the interrupted thread blocks on one of the other threads.

Note that the **pdbx** documentation uses "interrupted thread" in the same way the **dbx** documentation uses "running thread". Also, the **pdbx** documentation uses "displayed thread" in the same way the **dbx** documentation uses "current thread".

Related to this subcommand are the **attribute condition** and **mutex** subcommands.

trace subcommand (of the pdbx command)

trace [**in** <*procedure*>] [**if** <condition>]
trace <*source_line_number*> [**if** <condition>]
trace <*procedure*>
[**in** <*procedure*>]
[**if** <condition>]
trace <*variable*> [**in** <*procedure*>]
[**if** <condition>]
trace <*expression*> **at** <*source_line_number*>
[**if** <condition>]

Specifying **trace** with no arguments causes trace information to be displayed for every source line in your program.

Specifying **trace** <*source_line_number*> causes the tracepoint to be triggered each time that source line is reached.

Specifying **trace** [**in** <*procedure*>] causes the tracepoint to be triggered each time your program executes a source line within the procedure (function, subroutine).

Using the <*variable*> argument to trace causes the tracepoint to be triggered when the contents of the variable changes. This form of tracepoint can be very time consuming. For better results, when possible, further qualify these tracepoints with a *source_line* or *procedure* argument.

Specify the <*condition*> argument using the syntax described by "Specifying expressions" on page 30.

The **trace** subcommand sets tracepoints for tasks in the current context. These tracepoints will cause tracing information for the specified *procedure*, *function*, *sourceline*, *expression* or *variable* to be displayed when the program runs. The **trace** subcommand is context sensitive.

Use the **status** subcommand to display a list of tracepoints that have been set in the current context. Use the **delete** subcommand to remove tracepoints.

Specifying **trace** with no arguments causes trace information to be displayed for every source line in your program.

Specifying **trace** <*source_line_number*> causes the tracepoint to be triggered each time that source line is reached.

Specifying **trace** [**in** <*procedure*>] causes the tracepoint to be triggered each time your program executes a source line within the procedure (function, subroutine).

Using the <*variable*> argument to trace causes the tracepoint to be triggered when the contents of the variable changes. This form of tracepoint can be very time consuming. For better results, when possible, further qualify these tracepoints with a *source_line* or *procedure* argument.

Specify the <*condition*> argument using the syntax described by "Specifying expressions" on page 30.

Notes:

1. The **pdbx** debugger will not attempt to set a tracepoint at a line number when in a group context if the group members (tasks) have different current source files.
2. When specifying variable names as arguments to the **trace** subcommand, fully qualified names should be used. This should be done because, when a **trace** subcommand is issued, a parallel application could be in a different function on each node. This may result in ambiguity in variable name resolution. Use the **which** subcommand to get the fully qualified name for a variable.

To set a tracepoint for the variable "foo" at line 21 of a program, enter:

```
trace foo at 21
```

The **pdbx** debugger responds with a message like:

```
all:[1] trace foo at "bar.c":21
```

Related to this subcommand are the **dbx trace** and **which** subcommands, and the **pdbx stop**, **status**, and **delete** subcommands.

unalias subcommand (of the pdbx command)

unalias *alias_name*

The **unalias** subcommand removes **pdbx** command aliases. The *alias_name* specified is any valid alias that has been defined within your current **pdbx** session. The **unalias** subcommand is context insensitive.

To remove the alias “p”, enter:

```
unalias p
```

Related to this subcommand is the **pdbx alias** subcommand.

unhook subcommand (of the pdbx command)

unhook

The **unhook** subcommand enables you to unhook tasks. Unhooking allows tasks to run without intervention from the **pdbx** debugger. You can later reestablish control over unhooked tasks using the **hook** subcommand. The **unhook** subcommand is similar to the **detach** subcommand in **dbx**. It is context sensitive and has no parameters.

1. To unhook task 2, enter:
   ```
   on 2 unhook
   ```
   or
   ```
   on 2
   unhook
   ```
2. To unhook all the tasks in the task group “rest”, enter:
   ```
   on rest unhook
   ```
   or
   ```
   on rest
   unhook
   ```

Listing the members of the task group “all” using the **list** action of the **group** subcommand will allow you to check which tasks are hooked, and which are unhooked. Enter:

```
group list all
```

The **pdbx** debugger will display a list similar to the following:

```
0:D    1:U    2:D    3:D
```

Tasks marked with the letter U next to them are unhooked tasks. In this case, task 1 is unhooked. Tasks marked with the letter D are debug ready, hooked tasks. In this case, tasks 0, 2, and 3 are hooked.

Related to this subcommand is the **dbx detach** subcommand and the **pdbx hook** subcommand.

unset subcommand (of the pdbx command)

unset *name*

The **unset** subcommand removes the set variable associated with the specified *name*.

Related to this subcommand is the **set** subcommand.

up subcommand (of the pdbx command)

up [*count*]

The **up** subcommand moves the current function up the stack the number of levels you specify with the *count* parameter. The current function is used for resolving names. The default for the *count* parameter is 1.

The **up** and **down** subcommands can be used to navigate through the call stack. Using these subcommands to change the current function also causes the current file and local variables to be updated to the chosen stack level.

Related to this subcommand are the **down**, **print**, **dump**, **func**, **file**, and **where** subcommands.

use subcommand (of the pdbx command)

use [*directory ...*]

The **use** subcommand sets the list of directories to be searched when the **pdbx** debugger looks for source files. If the subcommand is specified without arguments, the current list of directories to be searched is displayed.

The @ (at sign) is a special symbol that directs **pdbx** to look at the full path name information in the object file, if it exists. If you have a relative directory called @ to search, you should use ./@ in the search path.

The **use** subcommand uses the + (plus sign) to add more directories to the list of directories to be searched. If you have a directory named +, specify the full path name for the directory (for example, ./+ or /tmp/+).

Related to this subcommand are the **file** and **list** subcommands.

whatis subcommand (of the pdbx command)

whatis *<name>*

The **whatis** subcommand displays the declaration of what you specify as the *name* parameter. The *name* parameter can designate a variable, procedure, or function name, optionally qualified with a block name.

Related to this subcommand are the **whereis** and **which** subcommands.

where subcommand (of the pdbx command)

where

The **where** subcommand displays a list of active procedures and functions. For example:

```
pdbx(all) where
init_trees(), line 23 in "funcs5.c"
colors(depth = 30, str = "This is it"), line 61 in "funcs5.c"
newmain(), line 59 in "funcs2.c"
f6(), line 25 in "funcs2.c"
main(argc = 1, argv = 0x2ff21c58), line 125 in "funcs.c"
```

Related to this subcommand are the **dbx up** and **down** subcommands.

whereis subcommand (of the pdbx command)

whereis *identifier*

The **whereis** subcommand displays the full qualifications of all the symbols whose names match the specified *identifier*. The order in which the symbols print is not significant.

Related to this subcommand are the **whatis** and **which** commands.

which subcommand (of the pdbx command)

which *identifier*

The **which** subcommand displays the full qualification of the given *identifier*. The full qualification consists of a list of the outer blocks with which the *identifier* is associated.

Related to this subcommand are the **whatis** and **whereis** subcommands.

pvt

NAME

pvt – Invokes the Profile Visualization Tool (PVT) in either its graphical-user-interface or command-line mode.

SYNOPSIS

pvt [**-c** [*one_or_more_file_names*]]
pvt -h

The **pvt** command starts the PVT in either its graphical-user-interface mode, or, if the **-c** flag is specified, its command-line mode. In either mode, you can specify one or more file names to start the PVT with profile data showing.

FLAGS

-c Specifies that the PVT should be started in command-line mode. Refer to "Using the Profile Visualization Tool's command line interface" on page 69 for information on the subcommands you can issue once the PVT is running in this mode.

-h Displays usage.

DESCRIPTION

The PVT is a postmortem analysis tool. It is designed to process profile data files generated by the PCT used in application profiling. You can run the PVT in either its graphical-user-interface mode, or, if the **-c** flag is specified, its command-line mode. After processing profile data, you can view the results in the PVT's graphical user interface display, outputted to report files, or saved to a summary file. The PVT provides a command-line interface to process individual profile files directly into a summary file without initializing the graphic display. The command-line interface also enables you to generate textual profile reports.

The **pvt** command's subcommands (for controlling the PVT in command-line mode) are listed alphabetically under "Subcommands of the pvt command" on page 137.

EXAMPLES

To start the PVT in graphical-user-interface mode showing an empty graphical user interface:

```
pvt
```

To start the PVT in graphical-user-interface mode with profile data showing:

```
pvt one_or_ more_file_names
```

To start the PVT in command-line mode:

```
pvt -c
```

To start the PVT in command-line mode with profile data showing:

```
pvt -c one_or_more_file_names
```

RELATED INFORMATION

Commands: **pct**(1)

Subcommands of the pvt command

exit subcommand (of the pvt command)

exit

The **exit** subcommand ends the command line session.

export subcommand (of the pvt command)

export *output_file_name*

The **export** subcommand allows you to export profile data to a specified file. The suffix *.txt* will be appended to the specified file name.

The currently loaded profile data is written to the user-specified file in plain text format, so the data can be loaded easily into a spreadsheet tool, like Lotus 1–2–3. The data that is loaded into the tool can be grouped into the following types of records:

- Profile-session records associated with each process
- Individual function or thread records
- Function statistics records.

help subcommand (of the pvt command)

help [*command_name*]

The **help** subcommand can either list all of the PVT's subcommands, or else return the syntax of a particular subcommand.

command_name
: refers to the name of the PVT subcommand you want help on.

For example, to get a listing of all of the PVT subcommands:

```
pvt> help
```

To get the syntax of the **report** subcommand:

```
pvt> help report
```

load subcommand (of the pvt command)

load *one_or_more_file_names*

The load subcommand loads a set of profile data files into the session. If a set of data already exists, then the existing data is discarded and the newly loaded data becomes the current data to be used in future actions.

report subcommand (of the pvt command)

report **[list** | *output_file_name* |
"one_or_more_report_names" output_file_name |
"one_or_more_report_ids" output_file_name]

The report subcommand generates textual reports on the profile data. To show a list of available report types, enter:

```
report list
```

The result of the command will look something like:

- **[0] call_count:** function call count report
- **[1] wclock:** wall clock timer report
- **[2] ru_cpu:** CPU usage reports
- **[3] ru_mem:** memory usage report
- **[4] ru_paging:** paging activities reports
- **[5] ru_cswitch:** context switch activities reports
- **[6] pmc_cycle:** instructions per cycle hardware counter reports
- **[7] pmc_fpu:** floating point hardware counter reports
- **[8] pmc_fxu:** fixed-point hardware counter reports
- **[9] pmc_branch:** branch hardware counter reports
- **[10] pmc_lsu:** load and store hardware counter reports
- **[11] pmc_cache:** cache hardware counter reports
- **[12] pmc_misc:** miscellaneous hardware counter reports

To generate all the available reports to a file, enter:

```
report output_file_name
```

To generate reports by report name, enter:

```
report "one_or_more_report_names" output_file_name
```

For example:

```
report "wclock,ru_cpu" output
```

To generate reports by report id, enter:

```
report "one_or_more_report_ids" output_file_name
```

For example:

```
report "1,2" output
```

The report names or report ids in double quotes must be separated by a comma with no blank space in between. No matter how many reports are selected in one report command, all the reports are outputted to a single file specified in the report command.

sum subcommand (of the pvt command)

sum *summary_file_name*

The sum subcommand creates a summary file of all the loaded data. The merged summary data is written to the file specified in the command.

slogmerge

NAME

slogmerge – Merges multiple UTE interval files into a single SLOG file.

SYNOPSIS

slogmerge [**-?**] [**-n** *number_of_files*] [**-c** *number_of_bytes_per_frame*] [**-o** *output_file_name*] [**-s** *range*] [**-m** *number_of_available_markers*] [**-r** *factor*] [**-g**] *input_file_name_prefix*

The **slogmerge** command merges multiple UTE interval trace files (whose names begin with the *input_file_name_prefix*) into a single SLOG file. The *input_file_name_prefix* must be the last item on the command line.

FLAGS

-? Prints out the usage information for the **slogmerge** command instead of performing the actual merge.

-n *number_of_files*
Specifies the number of input UTE interval files to be merged. The default value is 1.

-c *number_of_bytes_per_frame*
Specifies the number of bytes per frame. The default is 128K bytes.

-o *output_file_name*
Specifies the name for the output file — the merged SLOG file. The **slogmerge** utility will create a file with a .slog extension. If you do not specify an output file name, the default value is *trcfile.slog* in the current directory.

-s *range*
Specifies a list of MPI tasks to be merged. The task IDs in the list can be separated by either a comma (,) or a hyphen (-). If used, the hyphen represents a range of tasks. For example, `-s 0,2,4,5-7` indicates that the user wants to merge threads with MPI task IDs 0, 2, 4, 5, 6, and 7. By default, all tasks/threads in all UTE interval files will be merged.

-m *number_of_available_markers*
Specifies the number of spaces to reserve for user markers in the SLOG interval table. The number of available markers should not be less than the actual number of uniquely named user markers in the UTE trace file, or the **slogmerge** utility will quit. The default number of available markers is 20.

-r *factor*
specifies the factor by which spaces for ″pseudo records″ are reserved. The number of reserved slots for pseudo records is the number of threads in the trace file times the *factor*. If not specified, the default is 2.

Pseudo records are SLOG-specific interval records that are duplicates of certain internal records for visualization purposes. The number of pseudo records could be fairly high, depending on the number of nested states and their time span, and the number of internal records crossing SLOG frame boundaries in the trace. If the number of created pseudo records is more than the reserved slots during the merge process, the **slogmerge** utility will quit. If this happens, you should specify a larger number for this option to reserve more slots for pseudo records.

-g Merge interval files without using global clock records. This is needed when processing interval files generated on nodes with no high performance switch.

DESCRIPTION

The **slogmerge** command merges multiple UTE interval trace files into a single SLOG file. A number (as indicated by the **-n** option) of UTE files beginning with the *input_file_name_prefix* will be merged into an output file. The name of this output file is the one specified by the **-o** option, or, if the **-o** option is not specified, the file *trcfile.ute* in the current directory by default. The *input_file_name_prefix* must be the last item in the command line.

ENVIRONMENT VARIABLES

UTEPROFILE
: Specifies the name of the file description profile. If not set, the file */usr/lpp/ppe.perf/etc/profile.ute* is the default description profile. This variable is intended for use by IBM support personnel.

EXAMPLES

To merge 5 UTE interval trace files that begin with the prefix *mytrace* into a single SLOG file:

```
slogmerge -n 5 mytrace
```

The above example will create an SLOG file with the default output file name *trcfile.ute*. To specify your own output file name, use the **-o** option.

```
slogmerge -n 5 -o mergedtrc.ute mytrace
```

To additionally specify that only the MPI tasks 2, 4, and 6 through 9 should be merged into the SLOG file, use the **-s** option.

```
slogmerge -n 5 -o mergedtrc.ute -s 2,4,6-9 mytrace
```

FILES

profile.ute default description profile

RELATED INFORMATION

Commands: **uteconvert**(1), **utemerge**(1), **utestats**(1)

uteconvert

NAME

uteconvert – Converts AIX event trace files into UTE internal trace files.

SYNOPSIS

uteconvert [**-?**] [**-n** *number_of_files*]
[**-o** {*output_file_name* | *output_file_name_prefix*}] [**-r**]
{*input_file_name* | *input_file_name_prefix*}

The **uteconvert** command converts one or more AIX event trace files into one or more UTE interval trace files. The *input_file_name* (for converting a single AIX event trace file) or *input_file_name_prefix* (for converting multiple AIX event trace files) must be the last item on the command line.

FLAGS

-? Prints out usage information for the **uteconvert** command instead of converting AIX trace files.

-n *number_of_files*
Specifies the number of AIX event trace files to be converted. If not specified, the default is 1.

-o {*output_file_name* | *output_file_name_prefix*}
If the **-n** option specifies the number of files as 1 (the default), the **-o** option specifies the name of the resulting UTE interval file.

If the **-n** option specifies the number of files as greater than 1, the **-o** option specifies the file name prefix for the resulting UTE interval files. The names of the output files are formed by concatenating the given prefix with a node identifier, starting from 0.

-r removes AIX trace files after they have been processed.

DESCRIPTION

The **uteconvert** command converts one or more AIX event trace files into one or more UTE interval trace files. If the **-n** option specifies the number of files to be converted as 1 (the default), then you supply a single *input_file_name* to the **uteconvert** subcommand. If instead, the **-n** option specifies the number of files to be converted as greater than 1, then an *input_file_name_prefix* is supplied. The *input_file_name* or *input_file_name_prefix* must be the last item on the command line.

ENVIRONMENT VARIABLES

UTEPROFILE
Specifies the name of the file description profile. If not set, the file *profile.ute* in the current directory is the default description profile. This variable is intended for use by IBM support personnel.

EXAMPLES

To convert the AIX trace file *mytrace* into a UTE interval trace file:

```
uteconvert mytrace
```

To convert five trace files with the prefix *mytraces* into UTE interval trace files:

```
uteconvert -n 5 mytraces
```

FILES

profile.ute default description profile.

RELATED INFORMATION

Commands: **slogmerge**(1), **utemerge**(1), **utestats**(1)

utemerge

NAME

utemerge – Merges multiple UTE interval files into a single UTE interval file.

SYNOPSIS

utemerge [**-?**] [**-n** *number_of_files*] [**-o** *output_file_name*]
[**-s** *range*] [**-g**] *input_file_name_prefix*

The **utemerge** command merges multiple UTE interval trace files (whose names begin with the *input_file_name_prefix*) into a single UTE file. The *input_file_name_prefix* must be the last item on the command line.

FLAGS

-? Prints out the usage information for the **utemerge** command instead of performing the actual merge.

-n *number_of_files*
Specifies the number of input UTE interval files to be merged. The default value is 1.

-o *output_file_name*
Specifies the name for the output file — the merged UTE file. If not specified, the default value is *trcfile.ute* in the current directory.

-s *range*
Specifies a list of MPI tasks to be merged. The task IDs in the list can be separated by either a comma (,) or a hyphen (-). If used, the hyphen represents a range of tasks. For example, `-s 0,2,4,5-7` indicates that the user wants to merge threads with MPI task IDs 0, 2, 4, 5, 6, and 7. By default, all tasks/threads in all UTE interval files will be merged.

-g Merges interval files without using global clock results. This is needed when processing interval files generated on nodes with no SP switch.

DESCRIPTION

The **utemerge** command merges multiple UTE interval trace files into a single UTE interval trace file. A number (as indicated by the **-n** option) of UTE files beginning with the *input_file_name_prefix* will be merged into an output file. The name of this output file is the one specified by the **-o** option, or, if the **-o** option is not specified, the file *trcfile.ute* in the current directory by default. The *input_file_name_prefix* must be the last item in the command line.

ENVIRONMENT VARIABLES

UTEPROFILE
Specifies the name of the file description profile. If not set, the file */usr/lpp/ppe.perf/etc/profile.ute* is the default description profile. This variable is intended for use by IBM support personnel.

EXAMPLES

To merge 5 UTE interval trace files that begin with the prefix *mytrace* into a single UTE file:

```
utemerge -n 5 mytrace
```

The above example will create a UTE file with the default output file name *trcfile.ute*. To specify your own output file name, use the **-o** option.

```
utemerge -n 5 -o mergedtrc.ute mytrace
```

To additionally specify that only the MPI tasks 2, 4, and 6 through 9 should be merged into the UTE file, use the **-s** option.

```
utemerge -n 5 -o mergedtrc.ute -s 2,4,6-9 mytrace
```

FILES

profile.ute default description profile

RELATED INFORMATION

Commands: **uteconvert**(1), **slogmerge**(1), **utestats**(1)

utestats

NAME

utestats – Generates statistics tables from UTE interval files.

SYNOPSIS

utestats [**-?**] [**-o** *output_file_name*]
[**-B** *number_of_bins*] *input_file* [*input_file*]...

The **utestats** command generates statistics tables from one or more UTE interval file. By default, six two-dimensional tables are generated. These tables are:

- Time Bin vs. Node
- Thread vs. Event Type
- Event Type vs. Thread
- Node vs. Event Type
- Event Type vs. Node
- Node vs. Processor

The computed statistic for all tables is the sum of the duration. By default, the statistics tables will be written to standard output. You can optionally save the statistics tables to a file using the **-o** flag.

FLAGS

-? Prints out the usage information for the **utestats** command instead of generating statistics tables.

-o *output_file_name*
Specifies the name of a file to which the statistics tables will be saved. If not specified, the statistics tables will be written to standard output.

-B *number_of_bins*
Specifies the number of bins in the Time vs. Node table. The default is 50.

DESCRIPTION

The **utestats** utility is able to take individual UTE interval files or a merged UTE interval file as input. If a number of individual UTE interval files are specified, the timestamps in each file will start at 0 without alignment with respect to global clock values. If, instead, a merged UTE interval file is specified, the timestamps of records from different nodes will already have been adjusted with respect to the global clock value.

By default, six two-dimensional tables are generated. These tables are:

- Time Bin vs. Node
- Thread vs. Event Type
- Event Type vs. Thread (a row/column transposition of the Thread vs. Event Type table)
- Node vs. Event Type
- Event Type vs. Node (a row/column transposition of the Node vs. Event Type table)
- Node vs. Processor

The computed statistic for all the tables is the sum or the duration. As you can see, several tables are simply row/column transpositions of other tables. These transposed tables are provided so that a program used to visualize the tables does not have to transpose a table in order to show a transposed view.

The output of the **utestats** command is written in tab-separated-value format; each line of output is a row of a table, and columns in a row are separated by a tab character. Tables are separated by a Form Feed character (0x0c). This format is used to make it easy to import a **utestats** output file into a spreadsheet program.

A Node vs. Processor table would look like the following (where the tabs have been replaced by spaces to make the column alignment clearer).

```
node/cpu            0              1
   0            2.823739        2.258315
   1            0.873746        4.241253
   2            0.956515        4.322891
   3            0.853188        4.334650
```

The first value ″node/cpu″ is the name of the table. It consists of the row title followed by a ″/″ followed by a column title. This table contains statistics aggregated over interval records whose field values for ″node″ and ″cpu″ are the same. The values ″node″ and ″cpu″ are the field names as stored in the UTE profile file. The rest of the values in the first row are the column labels; these are the values that appeared in the ″cpu″ field in at least one interval record.

With other rows, the first field is the row label; it is a value that appeared in the node field in at least one interval record. The other fields in a row are the accumulated duration of all interval records with the same (″node″, ″cpu″) pair of values. For example, the accumulated duration of all interval records for ″cpu″ 1 of ″node″ 0 was 2.258315 seconds.

ENVIRONMENT VARIABLES

UTEPROFILE
: Specifies the name of the file description profile. If not set, the file *profile.ute* in the current directory is the default description profile. This variable is intended for use by IBM support personnel.

EXAMPLES

To generate statistics tables for a single UTE interval file:

```
utestats mytrace.ute
```

The above example will write the statistics tables to standard output. To redirect the output to a file, use the **-o** option.

```
utestats -o stattables mytrace.ute
```

You can also specify multiple UTE interval files from which statistics should be generated.

```
utestats mytrace.ute mytrace2.ute mytrace3.ute
```

FILES

profile.ute default description profile

RELATED INFORMATION

Commands: **uteconvert**(1), **utemerge**(1)

Appendix B. Command line flags for normal or attach mode

This appendix lists the command line flags that **poe** and **pdbx** use, indicating which ones are valid in normal and in attach debugging mode. When starting in attach mode, the debugger gives a message listing the invalid flags used, and then exits.

Table 7. Command Line Flags for Normal or Attach Mode

Flag	Description	Normal Mode	Attach Mode
-procs	number of processors	yes	no
-hostfile	name of host list file	yes	no
-hfile	name of host list file	yes	no
-infolevel	message reporting level	yes	yes
-ilevel	message reporting level	yes	yes
-retry	wait for processors	yes	no
-resd	directive to use Resource Manager	yes	no
-euilib	eui library to use	yes	no
-euidevice	adapter set to use for message passing.	yes	no
-euidevelop	EUI develop mode	yes	no
-newjob	submit new PE jobs without exiting PE	no	no
-pmdlog	use pmd logfile	yes	yes
-savehostfile	list of hosts from resource manager	yes	no
-cmdfile	PE command file	no	no
-stdoutmode	STDOUT mode	yes	no
-stdinmode	STDIN mode	yes	no
-labelio	label output	yes	yes - debugger only
-euilibpath	eui library path	yes	no
-pgmmodel	programming model	no	no
-retrycount	retry count for node allocation	yes	no
-rmpool	default pool for job manager	yes	no
-cpu_use	cpu usage	yes	no
-adapter_use	adapter usage	yes	no
-pulse	poe pulse	no	no
-d	nesting depth of program blocks	yes	yes
-I (upper case i)	path to search for source files	yes	yes
-x	prevents the dbx command from stripping trailing underscore in Fortran	yes	yes
-a	start in attach mode	N/A	yes

Appendix C. Profiling programs with the AIX prof and gprof commands

The difference between profiling serial and parallel applications with the AIX profilers is that serial applications can be run to generate a single profile data file, while a parallel application can be run to produce many.

You request parallel profiling by setting the compile flag to **-p** or **-pg** as you would with serial compilation. The parallel profiling capability of PE creates a monitor output file for each task.

With AIX Version 5.3, there is a difference in the file format and name; AIX 5.3 allows the profiling output files to have a user-specified name, depending on the setting of **PROF** and **GPROF** environment variables (the **PROF** and **GPROF** environment variables are not supported in AIX 5.2). With AIX 5.3, there is additional profiling support for threads and options that affect the type of profiling data that is collected, in addition to other factors that also affect how the profiling output files will be named.

For AIX 5.2, the files are created in the current directory, and are identified by the name **mon.out.taskid** or **gmon.out.taskid**, where *taskid* is a number between 0 and one less than the number of tasks.

For AIX 5.3, the files are created in the current directory and are named based on the settings of the **PROF** and **GPROF** environment variables, as described below. In all cases *taskid* is a number between 0 and one less than the number of tasks.

- When neither **PROF** nor **GPROF** are set, the default file names are **mon.taskid.out** or **gmon.taskid.out**, respectively.
- When an alternative file name is specified with **PROF**, the parallel profiling output file names are *filename***.taskid.out**.
- When **GPROF** is specified, the resulting output file names are a factor of the keywords specified in the **GPROF** environment variable, as documented by the AIX 5.3 **gprof** command, where the resulting file name will have the *taskid* value appended in the filename prefix string (as defined by the **GPROF filename:** keyword). For example, the following combinations of file names are possible, based on the **GPROF** settings, for parallel profiling output files:
  - For multi file-type: *prefix***-processname-pid.taskid.out**
  - For multithread file-type: *prefix***-processname-pid-Pthread***threaded***.taskid.out**

  The *prefix* default is **gmon**. You can define your own prefix by using the filename parameter of the **GPROF** environment variable. Note that the position where the *taskid* is appended in the file name has changed for parallel profiling output files on AIX 5.2 and 5.3.

In addition, with the added capabilities of the AIX 5.3 **GPROF** environment variable, a program compiled with **-pg** potentially produces multiple output files in both the serial and parallel cases, if **profile:thread** is specified as part of **GPROF**. Furthermore, thread profiling capability is only available with profiling output files that are created with AIX 5.3. You cannot enable thread-level profiling by compiling an application with **-pg** in AIX 5.2 or earlier and running it in AIX 5.3. It is strongly suggested that you review the information on the **PROF** and

GPROF environment variables, and the **prof** and **gprof** commands in *AIX 5L Version 5.3 Commands Reference* and *AIX 5L Version 5.3 General Programming Concepts: Writing and Debugging Programs*.

Following the traditional method of profiling using the AIX operating system, you compile a serial application and run it to produce a single profile data file that you can then process using either the **prof** or **gprof** commands. With a parallel application, you compile and run it to produce a profile data file for each parallel task. You can then process one, some, or all the data files produced using either the **prof** or **gprof** commands. The following table describes how to profile parallel programs. For comparison, the steps involved in profiling a serial program are shown in the left-hand column of the table.

To Profile a Serial Program:	To Profile a Parallel Program:
Step 1: Compile the application source code using the **cc** command with either the **-p** or **-pg** flag.	Step 1: Compile the application source code using the command **mpcc_r** (for C programs), **mpCC_r** (for C++ programs), or **mpxlf_r** (for Fortran programs) as described in *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment*. You should use one of the standard profiling compiler options – either **-p** or **-pg** – on the compiler command. For more information on the compiler options **-p** and **-pg**, refer to their use on the **cc** command as described in *AIX 5L Version 5.2 Commands Reference* and *AIX 5L Version 5.2 General Programming Concepts: Writing and Debugging Programs* or *AIX 5L Version 5.3 Commands Reference* and *AIX 5L Version 5.3 General Programming Concepts: Writing and Debugging Programs*.
Step 2: Run the executable program to produce a profile data file. If you have compiled the source code with the **-p** option, the data file produced is named *mon.out*. for AIX 5.2. For AIX 5.3, the file name is based on the setting of the **PROF** keyword, in which **mon.out** is the default file name. If you have compiled the source code with the **-pg** option, the data file produced is named *gmon.out* for AIX 5.2. For AIX 5.3, the file name produced is based on the options that are specified in the **GPROF** keyword, with **gmon** as the default prefix.	Step 2: Before you run the parallel program, set the environment variable **MP_EUILIBPATH=/usr/lpp/ppe.poe/lib/profiled:/usr/lib/profiled:/lib/profiled : /usr/lpp/ppe.poe/lib**. If your message passing library is not in **/usr/lpp/ppe.poe/lib**, substitute your message passing library path. Run the parallel program. When the program ends, it generates a profile data file for each parallel task. For AIX 5.2, the system gives unique names to the data files by appending each task's identifying number to *mon.out* or *gmon.out*. If you have compiled the source code with the **-p** option, the data files produced take the form: **mon.out.***taskid* For AIX 5.3, the output file for source code that is compiled with the **-p** option is based on the **PROF** keyword setting plus the taskid. In this case, **mon.taskid.out** is the default. For AIX 5.2, if the source code has been compiled with the **-pg** option, the data files produced take the form: **gmon.out.***taskid* For AIX 5.3, the file name produced is based on the options that are specified in the **GPROF** keyword, with **gmon** as the default prefix and the taskid appended. In this case, **gmon.taskid.out** is the default. **Note:** The current directory must be writable from all remote nodes. Otherwise, the profile data files will have to be manually moved to the home node for analysis with **prof** and **gprof**. You can also use the **mcpgath** command to move the files. See *IBM Parallel Environment for AIX: Operation and Use, Volume 1, Using the Parallel Operating Environment* for more about **mcpgath**.

To Profile a Serial Program:	To Profile a Parallel Program:
Step 3: Use either the **prof** or the **gprof** command to process the profile data file. You use the **prof** command to process the *mon.out* data file, and the **gprof** command to process the *gmon.out* data file for AIX 5.2. In AIX 5.3, the profile data files are based on the PROF and GPROF environment variable settings.	Step 3: Use either the **prof** or **gprof** command to process the profile data files. In AIX 5.2, the **prof** command processes the *mon.out* data files, and **gprof** processes the *gmon.out* data files. In AIX 5.3, the file names are based on the PROF and GPROF environment variable settings. Note that the position in the file name in which taskid is appended has changed for parallel profiling output files on AIX 5.2 and AIX 5.3. You can process one, some, or all of the data files created during the run. You must specify the name(s) of the profile data file(s) to read, however, because the **prof** and **gprof** commands read *mon.out* or *gmon.out* by default. On the **prof** command, use the **-m** flag to specify the name(s) of the profile data file(s) it should read. For example, to specify the profile data file for task 0 with the **prof** command: **On AIX 5.2, ENTER** **prof -m mon.out.***0* **On AIX 5.3, assuming the default case, ENTER** **prof -m mon.***0***.out** You can also specify that the **prof** command should take profile data from some or all of the profile data files produced. For example, to specify three different profile data files – the ones associated with tasks 0, 1, and 2 – on the **prof** command: **On AIX 5.2, ENTER** **prof -m mon.out.***0* **mon.out.***1* **mon.out.***2* **On AIX 5.3, ENTER** **prof -m mon.***0***.out mon.***1* **.out mon.***2***.out** On the **gprof** command, you simply specify the name(s) of the profile data file(s) it should read on the command line. You must also specify the name of the program on the **gprof** command, but no option flag is needed. For example, to specify the profile data file for task 0 with the **gprof** command: **For AIX 5.2, ENTER** **gprof** *program* **gmon.out**.*0* **For AIX 5.3, assuming the default case, ENTER** **gprof** *program* **gmon.***0***.out** As with the **prof** command, you can also specify that the **gprof** command should take profile data from some or all of the profile data files produced. For example, to specify three different profile data files – the ones associated with tasks 0, 1, and 2 – on the **gprof** command: **For AIX 5.2, ENTER** **gprof** *program* **gmon.out.***0* **gmon.out.***1* **gmon.out.***2* **For AIX 5.3, ENTER** **gprof** *program* **gmon.***0***.out gmon.***1***.out gmon.***2***.out**

The parallel utility, **mp_profile**( ), may also be used to selectively profile portions of a program. To start profiling, call **mp_profile**(1). To suspend profiling, call **mp_profile**(0). The final profile data set will contain counts and CPU times for the program lines that are delimited by the start and stop calls. In C, the calls are **mpc_profile**(1), and **mpc_profile**(0). By default, profiling is active at the start of the user's executable.

Note: Like the sequential version of **prof/gprof**, if more than one profile file is specified, the parallel version of the **prof/gprof** command output shows the sum of the profile information in the given profile files. There is no statistical analysis contacted across the multiple profile files.

Appendix D. Supported Power5 PMAPI hardware counter groupings

This appendix lists the supported groups for POWER5 hardware.

Group name

- Group description
- Event counted in counter 0
- Event counted in counter 1
- ...
- Event counted in counter 5

pm_utilization

- (CPI and utilization data)
- 0: Run cycles
- 1: Instructions completed
- 2: Instructions dispatched
- 3: Processor cycles
- 4: Instructions completed
- 5: Run cycles

pm_lsu1

- (LSU LRQ and LMQ events)
- 0: LRQ slot 0 allocated
- 1: LRQ slot 0 valid
- 2: LMQ slot 0 allocated
- 3: LMQ slot 0 valid
- 4: Instructions completed
- 5: Run cycles

pm_lsu2

- (LSU SRQ events)
- 0: SRQ slot 0 allocated
- 1: SRQ slot 0 valid
- 2: SRQ sync duration
- 3: Cycles SRQ full
- 4: Instructions completed
- 5: Run cycles

pm_prefetch1

- (Prefetch stream allocation)
- 0: Instructions fetched missed L2
- 1: Cycles at least 1 instruction fetched
- 2: D cache out of prefetch streams
- 3: D cache new prefetch stream allocated
- 4: Instructions completed
- 5: Run cycles

pm_misc_load

- (Non-cacheable loads and stcx events)
- 0: Stcx failed
- 1: Stcx passes
- 2: LSU0 non-cacheable loads
- 3: LSU1 non-cacheable loads
- 4: Instructions completed
- 5: Run cycles

pm_branch_miss

- (Branch mispredict)
- 0: TLB misses
- 1: SLB misses
- 2: Branch mispredictions due to CR bit setting
- 3: Branch mispredictions due to target address
- 4: Instructions completed
- 5: Run cycles

pm_L1_slbmiss

- (L1 load and SLB misses)
- 0: Data SLB misses
- 1: Instruction SLB misses
- 2: LSU0 L1 D cache load misses
- 3: LSU1 L1 D cache load misses
- 4: Instructions completed
- 5: Run cycles

pm_L1_dtlbmiss_4K

- (L1 load references and 4K Data TLB references and misses)
- 0: Data TLB reference for 4K page
- 1: Data TLB miss for 4K page
- 2: LSU0 L1 D cache load references
- 3: LSU1 L1 D cache load references
- 4: Instructions completed
- 5: Run cycles

pm_L1_dtlbmiss_16M

- (L1 store references and 16M Data TLB references and misses)
- 0: Data TLB reference for 16M page
- 1: Data TLB miss for 16M page
- 2: LSU0 L1 D cache store references
- 3: LSU1 L1 D cache store references
- 4: Instructions completed
- 5: Run cycles

pm_dsource1

- (L3 cache and memory data access)
- 0: Data loaded from L3
- 1: Data loaded from local memory

- 2: Flushes
- 3: Instructions completed
- 4: Instructions completed
- 5: Run cycles

pm_dsource2

- (L3 cache and memory data access)
- 0: Data loaded from L3
- 1: Data loaded from local memory
- 2: Data loaded missed L2
- 3: Data loaded from remote memory
- 4: Instructions completed
- 5: Run cycles

pm_dsource_L2

- (L2 cache data access)
- 0: Data loaded from L2.5 shared
- 1: Data loaded from L2.5 modified
- 2: Data loaded from L2.75 shared
- 3: Data loaded from L2.75 modified
- 4: Instructions completed
- 5: Run cycles

pm_dsource_L3

- (L3 cache data access)
- 0: Data loaded from L3.5 shared
- 1: Data loaded from L3.5 modified
- 2: Data loaded from L3.75 shared
- 3: Data loaded from L3.75 modified
- 4: Instructions completed
- 5: Run cycles

pm_isource1

- (Instruction source information)
- 0: Instruction fetched from L3
- 1: Instruction fetched from L1
- 2: Instructions fetched from prefetch
- 3: Instruction fetched from remote memory
- 4: Instructions completed
- 5: Run cycles

pm_isource2

- (Instruction source information)
- 0: Instructions fetched from L2
- 1: Instruction fetched from local memory
- 2: Instructions completed
- 3: No instructions fetched
- 4: Instructions completed
- 5: Run cycles

pm_isource_L2

- (L2 instruction source information)
- 0: Instruction fetched from L2.5 shared
- 1: Instruction fetched from L2.5 modified
- 2: Instruction fetched from L2.75 shared
- 3: Instruction fetched from L2.75 modified
- 4: Instructions completed
- 5: Run cycles

pm_isource_L3

- (L3 instruction source information)
- 0: Instruction fetched from L3.5 shared
- 1: Instruction fetched from L3.5 modified
- 2: Instruction fetched from L3.75 shared
- 3: Instruction fetched from L3.75 modified
- 4: Instructions completed
- 5: Run cycles

pm_fpu1

- (Floating Point events)
- 0: FPU executed FDIV instruction
- 1: FPU executed multiply-add instruction
- 2: FPU executing FMOV or FEST instructions
- 3: FPU executed FEST instruction
- 4: Instructions completed
- 5: Run cycles

pm_fpu2

- (Floating Point events)
- 0: FPU executed one flop instruction
- 1: FPU executed FSQRT instruction
- 2: FPU executed FRSP or FCONV instructions
- 3: FPU produced a result
- 4: Instructions completed
- 5: Run cycles

pm_fpu3

- (Floating point events)
- 0: FPU received denormalized data
- 1: FPU stalled in pipe3
- 2: FPU0 produced a result
- 3: FPU1 produced a result
- 4: Instructions completed
- 5: Run cycles

pm_fpu4

- (Floating point events)
- 0: FPU executed single precision instruction
- 1: FPU executed store instruction

- 2: Instructions completed
- 3: LSU executed Floating Point load instruction
- 4: Instructions completed
- 5: Run cycles

pm_fpu5

- (Floating point events by unit)
- 0: FPU0 executed FSQRT instruction
- 1: FPU1 executed FSQRT instruction
- 2: FPU0 executed FEST instruction
- 3: FPU1 executed FEST instruction
- 4: Instructions completed
- 5: Run cycles

pm_fpu6

- (Floating point events by unit)
- 0: FPU0 received denormalized data
- 1: FPU1 received denormalized data
- 2: FPU0 executed FMOV or FEST instructions
- 3: FPU1 executing FMOV or FEST instructions
- 4: Instructions completed
- 5: Run cycles

pm_fpu7

- (Floating point events by unit)
- 0: FPU0 executed FDIV instruction
- 1: FPU1 executed FDIV instruction
- 2: FPU0 executed FRSP or FCONV instructions
- 3: FPU1 executed FRSP or FCONV instructions
- 4: Instructions completed
- 5: Run cycles

pm_fpu8

- (Floating point events by unit)
- 0: FPU0 stalled in pipe3
- 1: FPU1 stalled in pipe3
- 2: Instructions completed
- 3: FPU0 executed FPSCR instruction
- 4: Instructions completed
- 5: Run cycles

pm_fpu9

- (Floating point events by unit)
- 0: FPU0 executed single precision instruction
- 1: FPU1 executed single precision instruction
- 2: LSU0 executed Floating Point load instruction
- 3: LSU1 executed Floating Point load instruction
- 4: Instructions completed
- 5: Run cycles

pm_fpu10

- (Floating point events by unit)
- 0: FPU0 executed multiply-add instruction
- 1: FPU1 executed multiply-add instruction
- 2: Instructions completed
- 3: FPU1 executed FRSP or FCONV instructions
- 4: Instructions completed
- 5: Run cycles

pm_fpu11

- (Floating point events by unit)
- 0: FPU0 executed add, mult, sub, cmp or sel instruction
- 1: FPU1 executed add, mult, sub, cmp or sel instruction
- 2: FPU0 produced a result
- 3: Instructions completed
- 4: Instructions completed
- 5: Run cycles

pm_fpu12

- (Floating point events by unit)
- 0: FPU0 executed store instruction
- 1: FPU1 executed store instruction
- 2: LSU0 executed Floating Point load instruction
- 3: Instructions completed
- 4: Instructions completed
- 5: Run cycles

pm_fxu1

- (Fixed Point events)
- 0: FXU idle
- 1: FXU busy
- 2: FXU0 busy FXU1 idle
- 3: FXU1 busy FXU0 idle
- 4: Instructions completed
- 5: Run cycles

pm_lsref_L1

- (Load/Store operations and L1 activity)
- 0: Data loaded from L2
- 1: Instruction fetched from L1
- 2: L1 D cache store references
- 3: L1 D cache load references
- 4: Instructions completed
- 5: Run cycles

pm_lsref_L2L3

- (Load/Store operations and L2)
- 0: Data loaded from L3
- 1: Data loaded from local memory

- 2: L1 D cache store references
- 3: L1 D cache load references
- 4: Instructions completed
- 5: Run cycles

pm_lsref_tlbmiss

- (Load/Store operations and TLB misses)
- 0: Instruction TLB misses
- 1: Data TLB misses
- 2: L1 D cache store references
- 3: L1 D cache load references
- 4: Instructions completed
- 5: Run cycles

pm_Dmiss

- (Data cache misses)
- 0: Data loaded from L3
- 1: Data loaded from local memory
- 2: L1 D cache load misses
- 3: L1 D cache store misses
- 4: Instructions completed
- 5: Run cycles

pm_prefetchX

- (Prefetch events)
- 0: Processor cycles
- 1: Instruction prefetch requests
- 2: L1 cache data prefetches
- 3: L2 cache prefetches
- 4: Instructions completed
- 5: Run cycles

pm_branchX

- (Branch operations)
- 0: Unconditional branch
- 1: A conditional branch was predicted, target prediction
- 2: A conditional branch was predicted, CR prediction
- 3: Branches issued
- 4: Instructions completed
- 5: Run cycles

pm_fpuX1

- (Floating point events by unit)
- 0: FPU0 stalled in pipe3
- 1: FPU1 stalled in pipe3
- 2: FPU0 produced a result
- 3: FPU0 executed FPSCR instruction
- 4: Instructions completed
- 5: Run cycles

pm_fpuX2

- (Floating point events by unit)
- 0: FPU0 executed multiply-add instruction
- 1: FPU1 executed multiply-add instruction
- 2: FPU0 executed FRSP or FCONV instructions
- 3: FPU1 executed FRSP or FCONV instructions
- 4: Instructions completed
- 5: Run cycles

pm_fpuX3

- (Floating point events by unit)
- 0: FPU0 executed add, mult, sub, cmp or sel instruction
- 1: FPU1 executed add, mult, sub, cmp or sel instruction
- 2: FPU0 produced a result
- 3: FPU1 produced a result
- 4: Instructions completed
- 5: Run cycles

Appendix E. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size.

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Using assistive technologies

Assistive technology products, such as screen readers, function with user interfaces. Consult the assistive technology documentation for specific information when using such products to access interfaces.

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All implemented function in the PE MPI product is designed to comply with the requirements of the Message Passing Interface Forum, MPI: A Message-Passing Interface Standard. The standard is documented in two volumes, Version 1.1, University of Tennessee, Knoxville, Tennessee, June 6, 1995 and *MPI-2: Extensions to the Message-Passing Interface*, University of Tennessee, Knoxville, Tennessee, July 18, 1997. The second volume includes a section identified as MPI 1.2 with clarifications and limited enhancements to MPI 1.1. It also contains the extensions identified as MPI 2.0. The three sections, MPI 1.1, MPI 1.2 and MPI 2.0 taken together constitute the current standard for MPI.

PE MPI provides support for all of MPI 1.1 and MPI 1.2. PE MPI also provides support for all of the MPI 2.0 Enhancements, except the contents of the chapter titled *Process Creation and Management*.

If you believe that PE MPI does not comply with the MPI standard for the portions that are implemented, please contact IBM Service.

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Acknowledgments

The PE Benchmarker product includes software developed by the Apache Software Foundation, *http://www.apache.org*.

Glossary

A

AFS. Andrew File System.

address. A value, possibly a character or group of characters that identifies a register, a device, a particular part of storage, or some other data source or destination.

AIX. Abbreviation for Advanced Interactive Executive, IBM's licensed version of the UNIX operating system. AIX is particularly suited to support technical computing applications, including high-function graphics and floating-point computations.

AIXwindows Environment/6000. A graphical user interface (GUI) for the RS/6000. It has the following components:
- A graphical user interface and toolkit based on OSF/Motif
- Enhanced X-Windows, an enhanced version of the MIT X Window System
- Graphics Library (GL), a graphical interface library for the application programmer that is compatible with Silicon Graphics' GL interface.

API. Application programming interface.

application. The use to which a data processing system is put; for example, a payroll application, an airline reservation application.

argument. A parameter passed between a calling program and a called program or subprogram.

attribute. A named property of an entity.

Authentication. The process of validating the identity of a user or server.

Authorization. The process of obtaining permission to perform specific actions.

B

bandwidth. The difference, expressed in hertz, between the highest and the lowest frequencies of a range of frequencies. For example, analog transmission by recognizable voice telephone requires a bandwidth of about 3000 hertz (3 kHz). The bandwidth of an optical link designates the information-carrying capacity of the link and is related to the maximum bit rate that a fiber link can support.

blocking operation. An operation that does not complete until the operation either succeeds or fails. For example, a blocking receive will not return until a message is received or until the channel is closed and no further messages can be received.

breakpoint. A place in a program, specified by a command or a condition, where the system halts execution and gives control to the workstation user or to a specified program.

broadcast operation. A communication operation where one processor sends (or broadcasts) a message to all other processors.

buffer. A portion of storage used to hold input or output data temporarily.

C

C. A general-purpose programming language. It was formalized by Uniforum in 1983 and the ANSI standards committee for the C language in 1984.

C++. A general-purpose programming language that is based on the C language. C++ includes extensions that support an object-oriented programming paradigm. Extensions include:
- strong typing
- data abstraction and encapsulation
- polymorphism through function overloading and templates
- class inheritance.

chaotic relaxation. An iterative relaxation method that uses a combination of the Gauss-Seidel and Jacobi-Seidel methods. The array of discrete values is divided into sub-regions that can be operated on in parallel. The sub-region boundaries are calculated using the Jacobi-Seidel method, while the sub-region interiors are calculated using the Gauss-Seidel method. See also *Gauss-Seidel*.

client. A function that requests services from a server and makes them available to the user.

cluster. A group of processors interconnected through a high-speed network that can be used for high-performance computing.

Cluster 1600. See IBM @server Cluster 1600.

collective communication. A communication operation that involves more than two processes or tasks. Broadcasts, reductions, and the **MPI_Allreduce** subroutine are all examples of collective communication operations. All tasks in a communicator must participate.

command alias. When using the PE command-line debugger **pdbx**, you can create abbreviations for existing commands using the **pdbx alias** command. These abbreviations are known as *command aliases.*

Communication Subsystem (CSS). A component of the IBM Parallel System Support Programs for AIX that provides software support for the high performance switch. CSS provides two protocols: Internet Protocol (IP) for LAN-based communication and User Space protocol as a message passing interface that is optimized for performance over the switch. See also *Internet Protocol* and *User Space.*

communicator. An MPI object that describes the communication context and an associated group of processes.

compile. To translate a source program into an executable program.

condition. One of a set of specified values that a data item can assume.

control workstation. A workstation attached to the RS/6000 SP that serves as a single point of control allowing the administrator or operator to monitor and manage the system using IBM Parallel System Support Programs for AIX.

core dump. A process by which the current state of a program is preserved in a file. Core dumps are usually associated with programs that have encountered an unexpected, system-detected fault, such as a Segmentation Fault or a severe user error. The current program state is needed for the programmer to diagnose and correct the problem.

core file. A file that preserves the state of a program, usually just before a program is terminated for an unexpected error. See also *core dump.*

current context. When using the **pdbx** debugger, control of the parallel program and the display of its data can be limited to a subset of the tasks belonging to that program. This subset of tasks is called the *current context.* You can set the current context to be a single task, multiple tasks, or all the tasks in the program.

D

data decomposition. A method of breaking up (or decomposing) a program into smaller parts to exploit parallelism. One divides the program by dividing the data (usually arrays) into smaller parts and operating on each part independently.

data parallelism. Refers to situations where parallel tasks perform the same computation on different sets of data.

dbx. A symbolic command-line debugger that is often provided with UNIX systems. The PE command-line debugger **pdbx** is based on the **dbx** debugger.

debugger. A debugger provides an environment in which you can manually control the execution of a program. It also provides the ability to display the program' data and operation.

distributed shell (dsh). An IBM Parallel System Support Programs for AIX command that lets you issue commands to a group of hosts in parallel. See *IBM Parallel System Support Programs for AIX: Command and Technical Reference* for details.

domain name. The hierarchical identification of a host system (in a network), consisting of human-readable labels, separated by decimal points.

DPCL target application. The executable program that is instrumented by a Dynamic Probe Class Library (DPCL) analysis tool. It is the process (or processes) into which the DPCL analysis tool inserts probes. A target application could be a serial or parallel program. Furthermore, if the target application is a parallel program, it could follow either the SPMD or the MPMD model, and may be designed for either a message-passing or a shared-memory system.

E

environment variable. (1) A variable that describes the operating environment of the process. Common environment variables describe the home directory, command search path, and the current time zone. (2) A variable that is included in the current software environment and is therefore available to any called program that requests it.

Ethernet. A baseband local area network (LAN) that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and delayed retransmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD).

event. An occurrence of significance to a task — the completion of an asynchronous operation such as an input/output operation, for example.

executable. A program that has been link-edited and therefore can be run in a processor.

execution. To perform the actions specified by a program or a portion of a program.

expression. In programming languages, a language construct for computing a value from one or more operands.

F

fairness. A policy in which tasks, threads, or processes must be allowed eventual access to a resource for which they are competing. For example, if multiple threads are simultaneously seeking a lock, no set of circumstances can cause any thread to wait indefinitely for access to the lock.

FDDI. Fiber Distributed Data Interface.

Fiber Distributed Data Interface (FDDI). An American National Standards Institute (ANSI) standard for a local area network (LAN) using optical fiber cables. An FDDI LAN can be up to 100 kilometers (62 miles) long, and can include up to 500 system units. There can be up to 2 kilometers (1.24 miles) between system units and concentrators.

file system. In the AIX operating system, the collection of files and file management structures on a physical or logical mass storage device, such as a diskette or minidisk.

fileset. (1) An individually-installable option or update. Options provide specific functions. Updates correct an error in, or enhance, a previously installed program. (2) One or more separately-installable, logically-grouped units in an installation package. See also *licensed program* and *package.*

foreign host. See *remote host.*

FORTRAN. One of the oldest of the modern programming languages, and the most popular language for scientific and engineering computations. Its name is a contraction of *FORmula TRANslation.* The two most common FORTRAN versions are FORTRAN 77, originally standardized in 1978, and FORTRAN 90. FORTRAN 77 is a proper subset of FORTRAN 90.

function cycle. A chain of calls in which the first caller is also the last to be called. A function that calls itself recursively is not considered a function cycle.

functional decomposition. A method of dividing the work in a program to exploit parallelism. The program is divided into independent pieces of functionality, which are distributed to independent processors. This method is in contrast to data decomposition, which distributes the same work over different data to independent processors.

functional parallelism. Refers to situations where parallel tasks specialize in particular work.

G

Gauss-Seidel. An iterative relaxation method for solving Laplace's equation. It calculates the general solution by finding particular solutions to a set of discrete points distributed throughout the area in question. The values of the individual points are obtained by averaging the values of nearby points. Gauss-Seidel differs from Jacobi-Seidel in that, for the *i+1*st iteration, Jacobi-Seidel uses only values calculated in the *i*th iteration. Gauss-Seidel uses a mixture of values calculated in the *i*th and *i+1*st iterations.

global max. The maximum value across all processors for a given variable. It is global in the sense that it is global to the available processors.

global variable. A variable defined in one portion of a computer program and used in at least one other portion of the computer program.

gprof. A UNIX command that produces an execution profile of C, COBOL, FORTRAN, or Pascal programs. The execution profile is in a textual and tabular format. It is useful for identifying which routines use the most CPU time. See the man page on **gprof**.

graphical user interface (GUI). A type of computer interface consisting of a visual metaphor of a real-world scene, often of a desktop. Within that scene are icons, which represent actual objects, that the user can access and manipulate with a pointing device.

GUI. Graphical user interface.

H

high performance switch. The high-performance message-passing network of the RS/6000 SP that connects all processor nodes.

HIPPI. High performance parallel interface.

hook. A **pdbx** command that lets you re-establish control over all tasks in the current context that were previously unhooked with this command.

home node. The node from which an application developer compiles and runs his program. The home node can be any workstation on the LAN.

host. A computer connected to a network that provides an access method to that network. A host provides end-user services.

host list file. A file that contains a list of host names, and possibly other information, that was defined by the application that reads it.

host name. The name used to uniquely identify any computer on a network.

hot spot. A memory location or synchronization resource for which multiple processors compete excessively. This competition can cause a disproportionately large performance degradation when one processor that seeks the resource blocks, preventing many other processors from having it, thereby forcing them to become idle.

I

IBM @server Cluster 1600. An IBM @server Cluster 1600 is any PSSP or CSM-managed cluster comprised of POWER microprocessor based systems (including RS/6000 SMPs, RS/6000 SP nodes, and pSeries SMPs).

IBM Parallel Environment (PE) for AIX. A licensed program that provides an execution and development environment for parallel C, C++, and FORTRAN programs. It also includes tools for debugging, profiling, and tuning parallel programs.

installation image. A file or collection of files that are required in order to install a software product on a RS/6000 workstation or on SP system nodes. These files are in a form that allows them to be installed or removed with the AIX **installp** command. See also *fileset*, *licensed program*, and *package.*

Internet. The collection of worldwide networks and gateways that function as a single, cooperative virtual network.

Internet Protocol (IP). (1) The TCP/IP protocol that provides packet delivery between the hardware and user processes. (2) The SP switch library, provided with the IBM Parallel System Support Programs for AIX, that follows the IP protocol of TCP/IP.

IP. Internet Protocol.

J

Jacobi-Seidel. See *Gauss-Seidel.*

K

Kerberos. A publicly available security and authentication product that works with the IBM Parallel System Support Programs for AIX software to authenticate the execution of remote commands.

kernel. The core portion of the UNIX operating system that controls the resources of the CPU and allocates them to the users. The kernel is memory-resident, is said to run in *kernel mode* (in other words, at higher execution priority level than *user mode*), and is protected from user tampering by the hardware.

L

Laplace's equation. A homogeneous partial differential equation used to describe heat transfer, electric fields, and many other applications.

latency. The time interval between the instant when an instruction control unit initiates a call for data transmission, and the instant when the actual transfer of data (or receipt of data at the remote end) begins. Latency is related to the hardware characteristics of the system and to the different layers of software that are involved in initiating the task of packing and transmitting the data.

licensed program. A collection of software packages sold as a product that customers pay for to license. A licensed program can consist of packages and filesets a customer would install. These packages and filesets bear a copyright and are offered under the terms and conditions of a licensing agreement. See also *fileset* and *package.*

lightweight corefiles. An alternative to standard AIX corefiles. Corefiles produced in the *Standardized Lightweight Corefile Format* provide simple process stack traces (listings of function calls that led to the error) and consume fewer system resources than traditional corefiles.

LoadLeveler. A job management system that works with POE to let users run jobs and match processing needs with system resources, in order to make better use of the system.

local variable. A variable that is defined and used only in one specified portion of a computer program.

loop unrolling. A program transformation that makes multiple copies of the body of a loop, also placing the copies within the body of the loop. The loop trip count and index are adjusted appropriately so the new loop computes the same values as the original. This transformation makes it possible for a compiler to take additional advantage of instruction pipelining, data cache effects, and software pipelining.

See also *optimization.*

M

| **management domain .** A set of nodes configured for manageability by the Clusters Systems Management (CSM) product. Such a domain has a management server that is used to administer a number of managed nodes. Only management servers have knowledge of the whole domain. Managed nodes only know about the servers managing them; they know nothing of each other. Contrast with *peer domain*.

menu. A list of options displayed to the user by a data processing system, from which the user can select an action to be initiated.

message catalog. A file created using the AIX Message Facility from a message source file that contains application error and other messages, which can later be translated into other languages without having to recompile the application source code.

message passing. Refers to the process by which parallel tasks explicitly exchange program data.

Message Passing Interface (MPI). A standardized API for implementing the message-passing model.

MIMD. Multiple instruction stream, multiple data stream.

Multiple instruction stream, multiple data stream (MIMD). A parallel programming model in which different processors perform different instructions on different sets of data.

MPMD. Multiple program, multiple data.

Multiple program, multiple data (MPMD). A parallel programming model in which different, but related, programs are run on different sets of data.

MPI. Message Passing Interface.

N

network. An interconnected group of nodes, lines, and terminals. A network provides the ability to transmit data to and receive data from other systems and users.

Network Information Services. A set of UNIX network services (for example, a distributed service for retrieving information about the users, groups, network addresses, and gateways in a network) that resolve naming and addressing differences among computers in a network.

NIS. See *Network Information Services*.

node. (1) In a network, the point where one or more functional units interconnect transmission lines. A computer location defined in a network. (2) In terms of the RS/6000 SP, a single location or workstation in a network. An SP node is a physical entity (a processor).

node ID. A string of unique characters that identifies the node on a network.

nonblocking operation. An operation, such as sending or receiving a message, that returns immediately whether or not the operation was completed. For example, a nonblocking receive will not wait until a message is sent, but a blocking receive will wait. A nonblocking receive will return a status value that indicates whether or not a message was received.

O

object code. The result of translating a computer program to a relocatable, low-level form. Object code contains machine instructions, but symbol names (such as array, scalar, and procedure names), are not yet given a location in memory. Contrast with *source code.*

optimization. A widely-used (though not strictly accurate) term for program performance improvement, especially for performance improvement done by a compiler or other program translation software. An optimizing compiler is one that performs extensive code transformations in order to obtain an executable that runs faster but gives the same answer as the original. Such code transformations, however, can make code debugging and performance analysis very difficult because complex code transformations obscure the correspondence between compiled and original source code.

option flag. Arguments or any other additional information that a user specifies with a program name. Also referred to as *parameters* or *command-line options.*

P

package. A number of filesets that have been collected into a single installable image of licensed programs. Multiple filesets can be bundled together for installing groups of software together. See also *fileset* and *licensed program.*

parallelism. The degree to which parts of a program may be concurrently executed.

parallelize. To convert a serial program for parallel execution.

Parallel Operating Environment (POE). An execution environment that smooths the differences between serial and parallel execution. It lets you submit and manage parallel jobs. It is abbreviated and commonly known as POE.

parameter. (1) In FORTRAN, a symbol that is given a constant value for a specified application. (2) An item in a menu for which the operator specifies a value or for which the system provides a value when the menu is interpreted. (3) A name in a procedure that is used to refer to an argument that is passed to the procedure. (4) A particular piece of information that a system or application program needs to process a request.

partition. (1) A fixed-size division of storage. (2) In terms of the RS/6000 SP, a logical collection of nodes to be viewed as one system or domain. System partitioning is a method of organizing the SP system into groups of nodes for testing or running different levels of software of product environments.

Partition Manager. The component of the Parallel Operating Environment (POE) that allocates nodes, sets up the execution environment for remote tasks, and manages distribution or collection of standard input (STDIN), standard output (STDOUT), and standard error (STDERR).

pdbx. The parallel, symbolic command-line debugging facility of PE. **pdbx** is based on the **dbx** debugger and has a similar interface.

PE. The IBM Parallel Environment for AIX licensed program.

peer domain. A set of nodes configured for high availability by the RSCT configuration manager. Such a domain has no distinguished or master node. All nodes are aware of all other nodes, and administrative commands can be issued from any node in the domain. All nodes also have a consistent view of the domain membership. Contrast with *management domain*.

performance monitor. A utility that displays how effectively a system is being used by programs.

PID. Process identifier.

POE. Parallel Operating Environment.

pool. Groups of nodes on an SP system that are known to LoadLeveler, and are identified by a pool name or number.

point-to-point communication. A communication operation that involves exactly two processes or tasks. One process initiates the communication through a *send* operation. The partner process issues a *receive* operation to accept the data being sent.

procedure. (1) In a programming language, a block, with or without formal parameters, whose execution is invoked by means of a procedure call. (2) A set of related control statements that cause one or more programs to be performed.

process. A program or command that is actually running the computer. It consists of a loaded version of the executable file, its data, its stack, and its kernel data structures that represent the process's state within a multitasking environment. The executable file contains the machine instructions (and any calls to shared objects) that will be executed by the hardware. A process can contain multiple threads of execution.

The process is created with a **fork()** system call and ends using an **exit()** system call. Between **fork** and **exit**, the process is known to the system by a unique process identifier (PID).

Each process has its own virtual memory space and cannot access another process's memory directly. Communication methods across processes include pipes, sockets, shared memory, and message passing.

prof. A utility that produces an execution profile of an application or program. It is useful to identify which routines use the most CPU time. See the man page for **prof**.

profiling. The act of determining how much CPU time is used by each function or subroutine in a program. The histogram or table produced is called the execution profile.

Program Marker Array. An X-Windows run time monitor tool provided with Parallel Operating Environment, used to provide immediate visual feedback on a program's execution.

pthread. A thread that conforms to the POSIX Threads Programming Model.

R

reduced instruction-set computer. A computer that uses a small, simplified set of frequently-used instructions for rapid execution.

reduction operation. An operation, usually mathematical, that reduces a collection of data by one or more dimensions. For example, the arithmetic SUM operation is a reduction operation that reduces an array to a scalar value. Other reduction operations include MAXVAL and MINVAL.

Reliable Scalable Cluster Technology. A set of software components that together provide a comprehensive clustering environment for AIX. RSCT is the infrastructure used by a variety of IBM products to provide clusters with improved system availability, scalability, and ease of use.

remote host. Any host on a network except the one where a particular operator is working.

remote shell (rsh). A command supplied with both AIX and the IBM Parallel System Support Programs for AIX that lets you issue commands on a remote host.

RISC. See *reduced instruction-set computer*.

RSCT. See Reliable Scalable Cluster Technology.

RSCT peer domain. See *peer domain*.

S

shell script. A sequence of commands that are to be executed by a shell interpreter such as the Bourne shell (**sh**), the C shell (**csh**), or the Korn shell (**ksh**). Script commands are stored in a file in the same format as if they were typed at a terminal.

segmentation fault. A system-detected error, usually caused by referencing an non-valid memory address.

server. A functional unit that provides shared services to workstations over a network — a file server, a print server, or a mail server, for example.

signal handling. A type of communication that is used by message passing libraries. Signal handling involves using AIX signals as an asynchronous way to move data in and out of message buffers.

Single program, multiple data (SPMD). A parallel programming model in which different processors execute the same program on different sets of data.

source code. The input to a compiler or assembler, written in a source language. Contrast with *object code.*

source line. A line of source code.

SP. RS/6000 SP; a scalable system arranged in various physical configurations, that provides a high-powered computing environment.

SPMD. Single program, multiple data.

standard input (STDIN). In the AIX operating system, the primary source of data entered into a command. Standard input comes from the keyboard unless redirection or piping is used, in which case standard input can be from a file or the output from another command.

standard output (STDOUT). In the AIX operating system, the primary destination of data produced by a command. Standard output goes to the display unless redirection or piping is used, in which case standard output can go to a file or to another command.

STDIN. Standard input.

STDOUT. Standard output.

stencil. A pattern of memory references used for averaging. A 4-point stencil in two dimensions for a given array cell, x(i,j), uses the four adjacent cells, x(i-1,j), x(i+1,j), x(i,j-1), and x(i,j+1).

subroutine. (1) A sequence of instructions whose execution is invoked by a call. (2) A sequenced set of instructions or statements that can be used in one or more computer programs and at one or more points in a computer program. (3) A group of instructions that can be part of another routine or can be called by another program or routine.

synchronization. The action of forcing certain points in the execution sequences of two or more asynchronous procedures to coincide in time.

system administrator. (1) The person at a computer installation who designs, controls, and manages the use of the computer system. (2) The person who is responsible for setting up, modifying, and maintaining the Parallel Environment.

System Data Repository. A component of the IBM Parallel System Support Programs for AIX software that provides configuration management for the SP system. It manages the storage and retrieval of system data across the control workstation, file servers, and nodes.

T

target application. See *DPCL target application*.

task. A unit of computation analogous to an AIX process.

thread. A single, separately dispatchable, unit of execution. There can be one or more threads in a process, and each thread is executed by the operating system concurrently.

tracing. In PE, the collection of information about the execution of the program. This information is accumulated into a trace file that can later be examined.

tracepoint. Tracepoints are places in the program that, when reached during execution, cause the debugger to print information about the state of the program.

trace record. In PE, a collection of information about a specific event that occurred during the execution of your program. For example, a trace record is created for each send and receive operation that occurs in your program (this is optional and might not be appropriate). These records are then accumulated into a trace file that can later be examined.

U

unrolling loops. See *loop unrolling.*

user. (1) A person who requires the services of a computing system. (2) Any person or any thing that can issue or receive commands and message to or from the information processing system.

User Space. A version of the message passing library that is optimized for direct access to the high performance switch, that maximizes the performance capabilities of the SP hardware.

utility program. A computer program in general support of computer processes; for example, a diagnostic program, a trace program, a sort program.

utility routine. A routine in general support of the processes of a computer; for example, an input routine.

V

variable. (1) In programming languages, a named object that may take different values, one at a time. The values of a variable are usually restricted to one data type. (2) A quantity that can assume any of a given set of values. (3) A name used to represent a data item whose value can be changed while the program is running. (4) A name used to represent data whose value can be changed, while the program is running, by referring to the name of the variable.

view. (1) To display and look at data on screen. (2) A special display of data, created as needed. A view temporarily ties two or more files together so that the combined files can be displayed, printed, or queried. The user specifies the fields to be included. The original files are not permanently linked or altered; however, if the system allows editing, the data in the original files will be changed.

X

X Window System. The UNIX industry's graphics windowing standard that provides simultaneous views of several executing programs or processes on high resolution graphics displays.

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